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The Soil and Water Conservation Research Branch works in cooperation with the State Agricultural Experiment Stations.

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*Appointed October 26 to succeed the late Robert M. Salter whose untimely death on September 13 brought to a close a long and brilliant career of service in research and administration aimed at conservation and improvement of soil and water resources.

CONTENTS

IRRIGATION

Georgia

DISTRIBUTION PATTERN OF LARGE SPRINKLER SHOWS NEED FOR OVERLAP

John F. Thornton, Athens. --Distribution patterns were determined for a Rainbow Volume Gun Model B 12 sprinkler equipped with a 1-3/8-inch nozzle. Duplicate runs were made at pressures of 80, 100, and 120 pounds per square inch. The patterns were conducted on a nearly level terrain and under generally calm wind conditions (occasional puffs of 2 to 5 miles per hour). The sprinkler rotated about 2 revolutions per minute and was operated 30 minutes during each run. Distribution was measured by catching the water in No. 3 cans set 10 feet apart on a low axis.

A brief summary of the results is given below:

Distance from sprinkler	Water distributed per hour at operation pressure (Lbs./Sq. In.) of:		
	80	100	120
Feet	*Inches*	*Inches*	*Inches*
10	0.98	1.16	1.16
20	1.00	1.05	1.10
30	0.80	0.87	0.91
40	0.52	0.59	0.67
50	0.49	0.54	0.61
70	0.45	0.50	0.55
100	0.38	0.39	0.40
120	0.34	0.37	0.35
140	0.2[illegible]	0.28	0.27
160	0.1[illegible]	0.18	0.18
180	0.01	0.05	0.05

There was some distribution distortion due to wind and to changes in rate of rotation of the sprinkler head. However, as indicated by the data, there was a high rate of water application near the sprinkler with the rate diminishing to the outer reaches of the circle covered. Increasing the pressure exerted only slight effect upon the uniformity of distribution.

The study shows clearly the need for overlap if reasonably uniform distribution is to be achieved.

Virginia

IRRIGATION HELPS MAINTAIN PROPER GRASS-LEGUME RATIOS

J. Nick Jones, Jr., and R. E. Blaser, Blacksburg. --This experiment was designed to find pasture mixtures that respond best to irrigation at Blacksburg. The plots were seeded in August, 1952. Cutting practices that favor high yields for each mixture were begun in the spring of 1953. For example, the mixtures having alfalfa as the only legume were cut four times annually while those containing Ladino clover were cut when the growth reached a height of ten inches.

Yield of dry matter in tons per acre of various mixtures with and without irrigation in 1953 and 1954 at Blacksburg, Virginia.

Mixtures (Lbs. per acre)	Yield per acre			
	Irrigated		Not irrigated	
	1953	1954	1953	1954
A. Ky. bluegrass 15, white clover 2	4.70	3.95	2.37	.82
B. Ky. 31 fescue 8, ladino clover 2	5.95	3.95	3.62	.97
C. Orchard grass 8, ladino clover 2	5.45	4.03	3.09	.87
D. Reed canary grass 18, ladino clover 2	5.34	3.63	3.56	.83
E. U.S. perennial ryegrass 12, ladino clover 2	5.33	3.44	3.08	.96
F. Timothy 7, ladino clover 2	5.45	3.85	3.32	.84
G. Oklahoma bromegrass 12, ladino clover 2	5.27	3.29	3.51	.86
H. Alfalfa 20	4.12	5.92	1.78	1.60
I. Alfalfa 18, orchard grass 3	5.04	6.07	2.64	1.61
J. Trefoil 12, bluegrass 12	4.54	3.84	2.71	.94
K. Alfalfa 15, ladino clover 1, orchard grass 6	5.94	3.94	3.90	1.13
L. Ladino clover 2, Kentucky 31, fescue 4, orchard grass 4	5.83	4.06	3.47	1.08
M. Ladino clover 2, tall oatgrass 6, orchard grass 8.	5.60	4.18	3.34	.99
N. Ladino clover 1/2, trefoil 8, orchard grass 8	5.76	4.14	3.37	1.05

Rainfall during the March-October period was 20.57 and 21.67 inches, respectively, for 1953 and 1954, but it was very poorly distributed. Annual irrigations totaling 18.7 and 17.0 inches, respectively, were required to maintain root zone soil moisture above 50% of capacity during that two-year period. Optimum fertilization was followed for all mixtures.

The reduction in yields of the mixtures containing Ladino and white clovers with irrigation during the second year may have resulted from accumulated disease and insect damage and from changes in the plant root system. Second-year yield increases from alfalfa probably resulted from the additional lime applications which were found necessary to raise the soil pH to the desired level for that crop.

The prolonged droughts of the past several years have provided an unusual opportunity for obtaining higher responses from irrigation applications. The exceptionally high yield increases from irrigation obtained from all of the forage mixtures tested indicate only slight differences in response. The maintenance of optimum soil moisture throughout the season has encouraged encroachment of Ladino clover upon the other grasses thereby disrupting the proper grass-legume balance. Accordingly, it appears likely that consideration should be given to reducing the proportion of clover seed in the forage mixture where irrigation is to be used. Conversely, the non-irrigated controls show definitely that the legumes go out in periods of drought much faster than the best perennial grasses, thereby making it impossible to maintain desirable forage mixtures during prolonged drought periods without irrigation.

Maryland

STUDIES STARTED ON SEALING PONDS WITH PLASTIC FILMS

T. W. Edminster, Beltsville.--Leaking farm ponds have long been a problem in many parts of the humid region. Not only is it desirable to seal existing ponds which have developed excessive seepage losses, but it is also desirable to be able to locate new ponds at desirable sites regardless of underlying conditions.

To study possibilities of using plastic films for pond linings, several ponds have been lined recently and are now under observation. A 1/4-acre pond has been lined at Millwood, Va., with a single fabricated sheet of 8 mil thickness, black polyethylene film (in cooperation with John Kane, SCS), and a 3/4-acre pond at Clemson, S. C., was lined with a single fabricated sheet of 8 mil olive vinyl film (in cooperation with Prof. A. B. Snell). These liners covered the entire pond bottom below the waterline as shown in the photograph. Materials for both liners were supplied by the Bakelite Corporation.

Leaky pond lined with 8 mil black polyethelene film, Millwood, Va.

In another pond near Coshocton, Ohio, a 28' x 200' patch of Mylar film was applied over one side where fractured shale permitted water loss. Films of different thickness are being tested over natural ground surface and over sawdust, with and without a soil covering on top of the film. Materials for this study were supplied by DuPont.

Additional ponds will be put under test as time and facilities permit. It is expected that these observational studies will give some insight into the possibilities of using plastic films for pond liners and of the problems and costs encountered.

Georgia

NEW PLOT IRRIGATOR MAKES PRECISE OVERHEAD APPLICATIONS

G. N. Sparrow, Tifton. --Uniform application of desired and measured amounts of overhead irrigation water on to individual plots in field experiments has always presented a considerable problem to research men. However, a new device called a "field plot irrigator" appears to offer a satisfactory solution.

The irrigator, shown in the photograph, has a horizontal boom which travels back and forth across the plot and directs the water downward under pressure. A small gasoline engine furnishes power for moving the boom. The unit is wheel-mounted and can be moved from plot to plot.

The idea behind the irrigator was originally developed at Pennsylvania State University, and a smaller model was built there for use on forage crops. The present model, however, has undergone considerable modification to adapt it to larger plots of tall growing row crops. Initial modifications in design were made by Mr. Willis Edgerly of the Agricultural Engineering Research Branch, ARS, and others were made at Tifton during construction.

The irrigator was used successfully in a tobacco irrigation experiment involving plots 22.5 feet wide and 52 feet long. Excellent coverage of the plots was obtained even under moderately high winds. At no time did water drift onto adjacent plots.

One machine was used to make some 96 individual plot irrigations, and one man was sufficient to operate the machine.

Texas

WATER INTAKE RATES INCREASED BY ANNUAL SOIL IMPROVING CROP ROOTS

P. Earl Ross, Weslaco. --Use of Willamette vetch, Victor grain oats, Hubam clover, and English peas grown under furrow and ridge irrigation to improve intake rates on a sandy loam soil has been studied in the Lower Rio Grande Valley of Texas. Measurements of intake rates were made with concentric rings on February 1, in the bed immediately before shredding the crops, and on May 23, 112 days later. Practically identical soil moisture conditions existed within the soil profile at the time these measurements were made. The soil on which this experiment was conducted has a field capacity of 20.0 percent and a wilting percentage of 8 percent. All treatments were replicated four times. Results are shown in the following table:

Intake rates (inches per hour) after the 1st, 2nd, and 3rd hour of water application as influenced by various annual crops[1] grown on a sandy loam soil in the Lower Rio Grande Valley. Weslaco, Texas, 1955

Period of water application	Vetch		Oats		Hubam		Peas		Check	
	Before	After	Before	After	Before	After	Before	After	Before	After
1st hour.....	0.7	2.0	1.2	2.6	1.1	1.8	0.9	1.1	0.8	0.9
2nd hour.....	0.5	1.4	0.9	1.8	0.7	1.1	0.4	1.0	0.9	0.8
3rd hour.....	0.5	1.2	0.9	1.8	0.8	1.0	0.7	0.8	0.9	0.7

[1] Intake rates shown are those recorded before crop was shredded and 3-1/2 months later.

It can be seen that the intake rates were virtually unaffected by the various crops at the end of the growing period and before the crops were shredded. However, increases in intake rates ranging from two-fold to three-fold, approximately, were observed for the vetch, oats, and Hubam after the first, second, and third hour, the oats being the

most effective crop of those studied. Slight increases in rates were apparent when peas were grown, but it is doubtful that these differences were significant.

On the basis of root density studies, oats exceeded the vetch by 47%, the clover by 57%, and the peas by 71%. That is the same order in which the various crops rank when rated according to their effectiveness in increasing intake rates, but it is not known to what extent the increases can be attributed to the surface mulch condition or to greater root densities. Nevertheless, beneficial effects of crop residues on increasing intake rates under conditions of this experiment are noteworthy.

Texas

WATER INTAKE RATES ARE DECREASED BY TRACTOR TRAFFIC

P. Earl Ross, Weslaco.--In the experiment described under the heading "Water Intake Rates Increased by Annual Soil Improving Crop Roots," comparisons of relative intake rates were made with concentric rings placed in the furrow in which a tractor wheel had traveled and in the adjacent bed where the soil improving crops were grown. Results are shown in the following table:

Water intake rate (inches per hour) in furrows receiving tractor traffic as contrasted to that in adjacent bed three months after various crops grown on a sandy loam soil had been shredded and returned to soil surface. Lower Rio Grande Valley, Weslaco, Texas, 1955

Period of water application	Vetch		Oats		Hubam		Peas		Check	
	Furrow	Bed	Furrow	Bed	Furrow	Bed	Furrow	Bed	Furrow	Bed
1st hour.....	.6	2.0	.8	2.6	.5	1.8	.4	1.1	.4	.9
2nd hour.....	.4	1.4	.5	1.8	.3	1.1	.4	1.1	.4	.8
3rd hour.....	.5	1.2	.5	1.8	.3	1.0	.3	.8	.3	.7

It can be noted that, in general, the intake rate in the furrows went down to a third of the rate in the beds as a result of soil compaction from tractor wheel.

Texas

COTTON GOES NO DEEPER FOR WATER FOLLOWING ANNUAL COVER CROPS

P. Earl Ross, Weslaco.--Soil moisture samples were taken throughout the season in cotton following annual soil improving crops of Hubam clover, Willamette vetch, victor grain oats, and English peas, and clean fallow land.

The water lost from the soil prior to each cotton irrigation was not significantly different in soils following different crops or different from the moisture loss in the soil which had been free of vegetation during the growth period of the soil improving crops.

The soil moisture extraction patterns of the cotton do not reflect a deeper use of moisture by the cotton following the annual soil improving crops than the cotton following the check plot. This is true even though the soil moisture was depleted to a rather low level in the upper two feet during the maximum growing and fruiting period of the cotton. Before the May 5 irrigation, the moisture in the upper two feet had been depleted to 35% of the available moisture, and before the June 15 irrigation all but 24% of the available moisture in the first two feet had been used.

Root distribution. In root studies made at the termination of this experiment, no greater development of the cotton root system could be detected where either a soil improving crop or fallow preceded the cotton. Results given in the following table show a rather uniform depth of penetration and percent of roots found at various depths within the soil profile.

Root distribution patterns of annual cover crops and of cotton following the cover crops, shown in percentages of total roots at various depths under each crop, Weslaco, Tex., 1955

Depth of sample	Cotton after oats		Cotton after clover		Cotton after vetch		Cotton after peas		Cotton after clean fallow
	Cotton	Oats	Cotton	Clover	Cotton	Vetch	Cotton	Peas	Cotton
Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
6	20.8	23.7	18.2	38.1	19.9	58.8	17.4	26.8	23.2
12	20.7	12.0	13.8	9.7	20.0	13.2	15.1	15.7	17.0
18	18.2	15.3	14.8	12.4	14.0	6.1	14.4	5.6	11.7
24	10.6	13.8	14.3	11.2	10.2	4.4	6.1	5.5	8.6
30	5.3	11.2	10.5	9.1	10.0	10.5	5.4	4.6	6.5
36	7.1	8.0	7.6	6.5	9.7	.9	8.8	5.5	9.0
42	6.8	5.8	6.7	4.7	5.6	2.6	8.4	6.5	5.9
48	2.9	4.7	5.1	3.8	3.7	.9	11.8	.9	5.8
54	1.7	3.6	3.3	3.0	3.6	2.6	5.0	1.9	3.5
60	2.0	1.5	2.4	1.1	1.7	0	2.6	0	.8
66	1.8	.4	2.4	.3	1.2	0	2.5	0	.1
72	1.7	0	.8	0	.4	0	1.1	0	0
78	.6	0	.1	0	0	0	1.3	0	0

Previous experiments with cotton following perennial grasses and alfalfa on a finer textured soil at another location in the Valley showed that a very significant increase in use of deep soil moisture by cotton was obtained following the perennials. The difference can very possibly be due to the difference in the length of time which the two crops occupied the land. The perennials were on the land 2-1/2 years while the annuals occupied the land approximately 110 days or less than four months. The fact that the annuals did increase the water intake rates but did not materially alter the moisture use pattern points up the need for further investigations of the chemical and physical properties of the deeper soil profile following various soil improving crops. It could well be that the difference lies in the state of decomposition of the soil improving crops and the total amount of roots produced by the perennials vs. the annuals.

Production data lacking. It is unfortunate that production data could not be obtained for cotton following the annual soil improving crops. All plots were badly infested with cotton root rot which began before the cotton reached maturity and became progressively worse as the cotton matured. At the end of the harvest season, a survey of the cotton killed by root rot following each soil improving crop was as follows: 86.5% following oats; 78.0% following check plot; 67.0% following Hubam clover; 64.3% following English peas; and 55.5% following Willamette vetch. The pattern of the areas infested with root rot did not indicate that the cover crops reduced or increased the incidence of the disease.

Texas

EFFICIENT WATER USE IS MAIN OBJECTIVE OF RESEARCH IN HIGH PLAINS

M. E. Jensen, Amarillo. --Irrigation water in the High Plains is obtained from an underground reservoir having a limited supply. Maximum production per inch of irrigation water is the objective of new research projects being initiated at the Amarillo Experiment Station.

A comprehensive experiment has been started to determine the most efficient moisture and fertility level for wheat. This experiment has six fertility treatments superimposed on six moisture treatments. The moisture treatments consist of three soil moisture levels and three treatments irrigated on different dates.

Colorado

PARTICLE SIZES IN WELL FILTER AND AQUIFER NEED NOT BE UNIFORM

A. D. Halderman and A. R. Robinson, Fort Collins. --Failure of many irrigation well installations has been the result of the movement of sand from a fine, unconsolidated aquifer formation into the well.

A gravel filter may be provided to prevent sand movement and to lower the head loss near the well.

Previous investigations have established the required ratio between the filter and aquifer particle sizes for uniform aquifers and filters. This has been termed the pack-aquifer ratio and is defined as the ratio of the 50 per cent size of the gravel to the 50 per cent size in the aquifer. Studies in the past on the relationship of filter material to the aquifer have established allowable P-A ratios as ranging between 4 and 8.

The uniformity of a material refers to the range of sizes of particles and the uniformity coefficient is a ratio of the 60 per cent size to the 10 per cent size. A non-uniform material could be loosely defined as one for which the uniformity coefficient is greater than 2.

The results of recent studies indicated that non-uniformity of both the aquifer and filter might change the allowable pack-aquifer ratio. Therefore, a study was made to determine what limitations should be placed upon the present design criteria for uniform materials in order to adapt these criteria to non-uniform materials.

The data required were obtained by the use of equipment which permitted the testing of various filter and aquifer combinations. The tests were conducted with filter and aquifer materials combined in ratios found to be stable for uniform materials. The uniformity of both the filter and aquifer was varied, and effects on the amount of sand moved were observed. The weight of aquifer sand which was moved by the water into the filter was used as a measure of stability of the combination.

The results of this investigation may be summarized as follows:

1. The uniformity of an aquifer within the range of values tested does not limit the allowable P-A ratio.

2. The uniformity of the filter does not limit the allowable P-A ratio in the range tested.

3. The stability of a filter-aquifer system in the range tested was independent of the hydraulic gradient, the pore velocity and the Reynolds number.

The maximum rate of flow for the tests was equivalent to a rate which was above average for an actual well.

North Dakota

CORN YIELDS BEST WITH THICK STAND, FERTILIZER, IRRIGATION

Carl W. Carlson, D. L. Grunes, J. Alessi, G. A. Reichman, Mandan.--Farmers in the areas proposed for irrigation in North Dakota are primarily interested in the possibility of utilizing irrigation water for the production of such livestock feeds as corn silage and alfalfa. A field experiment was initiated at the Deep River Development Farm in the spring of 1955. Results are shown in the table that follows.

Yields per acre of corn (Nodak 301) as influenced by moisture, plant population, and fertilizer, Deep River Development Farm, North Dakota, 1955.

Fertilizer applied per acre $N-P_2O_5-K_2O$	Plant population per acre	Yields of corn per acre			
		Non-irrigated		Irrigated	
		Forage[1]	Grain[2]	Forage[1]	Grain[2]
Pounds	*Numbers*	*Pounds*	*Bushels*	*Pounds*	*Bushels*
0-200-0.....	10,250	5,540	47.8	6,910	58.4
30-200-0.....	10,250	5,500	44.6	----------	----------
60-200-0.....	10,250	5,630	48.6	7,650	61.4
120-200-0.....	10,250	5,730	49.4	7,720	62.1
0-200-0.....	18,450	5,880	45.1	8,680	79.0
60-200-0.....	18,450	5,330	45.6	9,520	80.6
120-200-0.....	18,450	6,150	48.5	9,890	84.7
180-200-0.....	18,450	----------	----------	9,820	83.6

[1] Oven dry weights.
[2] Yields corrected to 15% moisture content.

There were significant forage and grain yield increases due to increased plant population and to fertilizer treatment on the irrigated plots but not on the non-irrigated. In all cases the plots having the same plant population and receiving the same fertilizer treatment produced more forage and grain on the irrigated than on the non-irrigated. The highest forage and grain yields were obtained on the irrigated plots having the high plant population and receiving the high rates of fertilizer application. The moisture content of the corn grain produced on the irrigated plots and non-irrigated plots were not appreciably different, the average moisture being 46%. The average moisture content of the forage was 63% on the non-irrigated and 69% on the irrigated plots.

The rainfall for the growing season was slightly below the long time average. The soil moisture was near field capacity on both the irrigated and non-irrigated plots when the corn was planted on May 26. The irrigated plots received three water applications during the growing season. Soil moisture data showed that the non-irrigated plots reached the wilting point early in August.

California

EVAPORATION RECORDS FROM MANY SOURCES BROUGHT UP TO DATE

Gilbert L. Corey and Harry F. Blaney, Los Angeles.--A considerable number of local, State, and federal agencies secure evaporation records from many locations in California. Only the United States Weather Bureau regularly publishes its data. A report

consolidating all such records has been prepared covering the period 1949-1955, thus making current these data as published in California State Division of Resources Bulletins 54 and 54-A.

DRAINAGE

California

PUMPING IS POSSIBLE AID TO DRAINAGE IN SAN LUIS SCD

Leonard Schiff, Bakersfield. --A report of the high-water table problem of this district together with recommendations for drainage has been prepared in collaboration with Richard Willey of the SCS.

The survey indicates that shallow basic hydraulic gradients sweep into the district from rainfall and irrigation water applied to up-slope areas. Water mounds exist above the level of these hydraulic gradients.

Suggestions are made for further investigation to determine the feasibility of modifying the present drainage system by deepening some of the drains and providing lift pumps at major outlets. The hydraulic conductivity of some soils of the district is fairly high and may drain better than originally anticipated.

It is suggested that the wells might be used to draw down the water table. Several pumps in a portion of the area may be operated for this purpose on a trial basis. The effects of such operations on draw down would be studied by the use of shallow observation wells in the vicinity.

EROSION AND RUNOFF CONTROL

Maryland

TOBACCO PLANTER IS BEST MEANS OF ESTABLISHING ZOYSIA

C. S. Britt, C. S. Slater and W. W. Steiner, Beltsville. --Zoysia japonica meets most of the requirements of a grass for waterways from New Jersey south. The transplanting of sprigs or cut sod with a tobacco planter seems to be the best method for its establishment. Water applied at transplanting insures a high survival rate.

Two series of experiments were performed on plowed sandy land. In the first experiment the land was prepared in four different ways and the Zoysia sprigs were spread by hand at three different rates. The methods of planting:

1. Zoysia sprigs spread by hand, land then disked and cultipacked.
2. Land disked, Zoysia spread, followed by disking and cultipacking.
3. Land furrowed with springtooth harrow, Zoysia spread, land then cultipacked.
4. Land furrowed with springtooth harrow, Zoysia spread, land then disked and cultipacked.

The plots were planted in May 1954. The Zoysia sprigs from 2, 4, or 6 square feet of sod were used to plant 150 square feet of plot area.

The weather that followed planting was dry, and none of these plantings are considered satisfactory. Percentage coverage by Zoysia in August 1955 ranged from 5% to

30% on the individual plots. Differences between methods of land preparation were non-significant. The higher rates of planting gave the better stand as indicated below.

Sod used	2 sq. ft.	4 sq. ft.	6 sq. ft.
Zoysia cover (1955)	12%	17%	20%

The tobacco planter was used in the second experiment in comparison with various mulch treatments. This experiment was also put in in May 1954. Sprigs were dropped in furrows made with a springtooth harrow and foot-pressed into the soil on all plots except those planted with the tobacco planter. The plots were cultipacked after the sprigs were dropped. Sprigs were spaced approximately one foot apart.

Results to date from this research are as follows:

1. The broadcasting of Zoysia sprigs is not a satisfactory means of establishment and is wasteful of planting material.

2. An asphalt mulch had little or no net effect on the growth of Zoysia. It did hasten the germination of ryegrass and crabgrass.

3. Either mulch or ryegrass as a nurse crop improved the growth of Zoysia. However, mulch and ryegrass in combination did not. It is concluded that the ryegrass, benefited by the mulch, offered too strong competition for the Zoysia. This conclusion is supported by observations that Zoysia was hindered elsewhere on the plots wherever competition from crabgrass was severe.

4. The tobacco planter, which set the sprigs firmly and supplied transplanting water, gave outstandingly better results in comparison with any other method of establishment.

Kansas

BLOWING SOIL DELAYS WHEAT MATURITY; SPRING DAMAGE WORST

N. P. Woodruff, Manhattan.--Studies were conducted to obtain information on the extent of injury to winter wheat plants caused by soil blowing. The study was concerned primarily with injury occurring with varying amounts of blowing soil--all less than that required for lethal damage. The plants used in the study were subjected to varying intensities of blowing soil in the fall and in the spring in order to evaluate the extent of injury occurring at these two stages of growth.

Important results of the two-year study may be summarized as follows:

(1) Heading and ripening of the grain was found to be delayed 1 week to 10 days on those plants receiving severe exposures to blowing soil.

(2) Repeated exposure tests made at 1-week intervals indicated that the total amount of soil striking the plant was the important factor in depressing products of plant growth, rather than the length of time between exposures.

(3) Spring exposures caused a gradual depression of the products of plant growth with increased rates of soil movement. Fall exposures, on the other hand, caused drastic reductions in the products with initial small amounts of soil movement; then a slight increase in damage came with increased rates of movement; finally, as the rate increased to approximately 4.0 tons/ft./day, a gradual decrease in damage occurred. It is believed that a partial explanation of this phenomenon lies in the fact that the plant stomata open and close at different stages of growth and that the wind and soil therefore affect the transpiration rate differently at different times.

(4) Spring treatments had a greater depressing effect than fall treatments. Average yields, weights of plant material and numbers of heads for spring treatments were 45.4, 24.7, and 19.4 percent, respectively, less than fall treatments.

(5) The remarkable recuperative powers of the winter wheat plant were revealed by the rapid recovery made by some of the most severely damaged plants when placed in the greenhouse and given sufficient moisture.

SOIL FERTILITY

Mississippi

SULFATES ACCUMULATE IN LOWER HORIZONS OF SOUTHEASTERN SOILS

Howard V. Jordan and C. E. Bardsley, State College. --Studies throughout the Southeast show that soluble sulfate accumulates in the deeper horizons of the soil profile. The sulfate content of the plow-layer (0-6 inches), on the other hand, is often negligible. Some typical examples are given in the table below:

Parts per million of sulfate sulfur at different depths in some Southeastern soils.

Depth	Sulfate sulfur content		
	Cecil sandy loam Watkinsville, Ga.	Chewacla silt loam Clemson, S. Car.	Marlboro f.s.l. Rocky Mount, N. Car.
Inches	*p.p.m.*	*p.p.m.*	*p.p.m.*
0-6	2.1	1.1	1.3
6-12	43.2	0.7	35.9
12-18	165.5	1.4	156.9
18-24	186.8	5.5	234.1
24-30	186.3	23.6	284.0
30-36	160.5	47.4	262.7

The zone of sulfur accumulation may occur anywhere from 6 inches to 30 inches in depth. The accumulation seems to exist on cultivated and uncultivated lands alike. For example, several profile samples taken from old graveyards, virgin timber areas, and swamps had about the same sulfur distribution patterns as shown in the table above.

On farms where the sulfur accumulation occurs within 6 to 12 inches of the surface, crops usually obtain adequate sulfur for their growth except possibly in very early stages. Where the accumulation occurs at greater depths, sensitive and shallow-rooted crops may suffer from lack of sulfur unless adequate amounts are supplied either by sulfur-containing fertilizers or from other sulfur sources.

Georgia

LIME, FERTILIZERS GIVE GOOD CLOVER STANDS ON ACID SPOIL

A. E. Royer, Fleming. --Open ditch drainage is essential in wide areas of the Bladen belt of soils along the Southeastern coast of the United States. The excavated material is a heavy plastic clay, low in organic matter and mineral plant nutrients, and very acid in reaction. Disposition of this spoil is a serious problem. When spread over areas adjacent to drainage ditches, the spoil material destroys the productivity of the area covered. If it is piled along the edge of ditches, as is common practice, it blocks the entrance of surface drainage into the ditches.

With Caladino clover as a test crop, combination treatments of four levels of phosphorus, two levels of potassium and three levels of lime were compared on the subsoil spoil material from a Bladen clay loam soil at Fleming, Georgia. Treatments were replicated four times. The first year's results are shown below.

Yields per acre of Caladino clover, 16% moisture, from first two clippings of plots in fertilizer trial on Bladen ditch spoil material, Fleming, Ga., 1955

Treatment per acre		Yield per acre
Lime	P_2O_5	
Tons	*Pounds*	*Pounds*
2	0	1,196
	60	1,800
	120	1,936
	240	2,123
Average,	1,764	
4	0	2,065
	60	2,798
	120	2,831
	240	2,816
Average,	2,627	
8	0	2,295
	60	2,702
	120	2,667
	240	2,810
Average,	2,618	
Average, 0 pounds P_2O_5--1,852		
Average, 60 pounds P_2O_5--2,433		
Average, 120 pounds P_2O_5--2,478		
Average, 240 pounds P_2O_5--2,583		

Treatment per acre		Yield per acre
K_2O	P_2O_5	
Pounds	*Pounds*	*Pounds*
60	0	1,197
	60	2,415
	120	2,517
	240	2,749
Average, treatments with 60 lbs. K_2O--2,399		
120	0	1,786
	60	2,452
	120	2,439
	240	2,416
Average, treatments with 120 lbs. K_2O--2,273		

The results of the first two clippings indicate that with moderate rates of fertilizer and lime good stands of clover can be obtained on ditch spoil material of Bladen and Bayboro soils. Good responses were obtained up to 60 pounds of P_2O_5 and to 4 tons of lime per acre. No response to potash above the minimum rate of 60 pounds per acre of K_2O was obtained.

New Mexico

IRRIGATED PASTURES NEED HIGH RATES OF NITROGEN FERTILIZATION

James A. Burr, Tucumcari. --Two fertilizer experiments were conducted in 1955 at Tobosa Flats on irrigated grass pastures. Various rates and combinations of nitrogen and phosphorus were applied to established stands of alta fescue and smooth brome grass. These two grasses are well adapted to the Montoya clay loam soil common to the Tobosa Flats area near Tucumcari, but their production has been very low in pastures in the area.

Twelve fertility treatments replicated four times were applied to each of the two grasses. Nitrogen and phosphorus were applied at three rates each (including 0 as one rate) in all combinations; in addition the highest rate of nitrogen was split three ways. All phosphorus (as treble superphosphate) and the first application of nitrogen (as

ammonium nitrate) were drilled April 20, 1955; the second application to treatments 10, 11, and 12 was applied July 6, and the third application to treatment 10 on August 1, 1955. The rates of N and P_2O_5 applied and the yields obtained from four cuttings are given in the accompanying table.

The plots were irrigated eight times and the area received 6.36 inches of rainfall during the growing season. There was a marked growth response to nitrogen after each application of nitrogen.

The following conclusions can be drawn from these data:

1. Nitrogen gave a highly significant increase in yield, with 120 pounds being better than 60 pounds.

2. Phosphorus had no significant influence on yield.

3. One application of 120 pounds of N was as effective as any of the split applications.

4. The fact that all plots showed signs of nitrogen deficiency at the end of the growing season indicates that higher rates of nitrogen are necessary for maximum production of grass pastures on Tobosa Flats.

5. While fertilization increased yields as much as 1.1 tons per acre, the top yield of 1.84 tons per acre was relatively low for irrigated pastures.

Yields of irrigated pastures (average of 4 replicates) as affected by fertilizer treatments, Tobosa Flats, Tucumcari, New Mex., 1955

Fertilizer applied per acre		Yields of Alta fescue per acre					Yields of smooth brome per acre				
N	P_2O_5	Cutting					Cutting				
		1	2	3	4	Total	1	2	3	4	Total
Pounds	*Pounds*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
0	0	.32	.08	.18	.15	.73	.19	.21	.15	.12	.67
60	0	.54	.17	.24	.17	1.12	.38	.35	.28	.27	1.28
120	0	.72	.39	.35	.24	1.70	.74	.36	.32	.23	1.65
0	40	.30	.09	.16	.16	.71	.25	.13	.19	.18	.75
60	40	.55	.21	.26	.21	1.23	.41	.21	.24	.18	1.04
120	40	.74	.45	.36	.29	1.84	.69	.37	.39	.26	1.71
0	80	.34	.08	.15	.16	.73	.18	.20	.19	.15	.72
60	80	.54	.19	.26	.21	1.20	.40	.33	.25	.16	1.14
120	80	.92	.39	.31	.24	1.80	.71	.43	.36	.29	1.79
40	80	.50	.19	.33	.48	1.50	.37	.27	.42	.41	1.47
60	80	.57	.23	.45	.30	1.55	.42	.28	.56	.32	1.58
80	80	.59	.30	.46	.31	1.66	.54	.28	.44	.28	1.54

L.S.D. (5% level) ..0.15.....0.18

FERTILIZERS APPLIED TO SORGHUM IN 1953 HAVE NO EFFECT IN 1954

Ross W. Leamer, State College.--Sorghums grown on Montoya clay loam soil in the Tucumcari Irrigation Project in New Mexico responded to nitrogen fertilizer. The yield and the percent N (or protein) of the grain were increased by nitrogen fertilization the year the fertilizers were applied. Sorghums grown on the same plots the second year showed no response in either yield or composition to any of the fertilizer treatments applied the first year.

These are the findings of a two-year fertilizer experiment conducted on Tobosa Flats near Tucumcari, New Mexico. The experiment included four replicates of 12 fertilizer treatments of various amounts and combinations of nitrogen, phosphorus and potash. All fertilizers were band placed three inches deep and two inches to the side of the row just before furrowing for the preplanting irrigation. Because of a poor stand from the first planting the plots were replanted on June 25, 1953. The plots were irrigated five times during the 1953 season, giving a net application of 20 acre inches per acre. The plots were harvested in October and the yield calculated in 56-pound bushels at 10-12 percent moisture. Subsamples of the grain were analyzed for percent P and total N content.

On May 10, 1954 the sorghum stalks remaining from the previous season were chopped with a stalk cutter. The area was double disked, furrowed and planted to sorghum. In the four months of May through August 1954, the experiment received 22 inches of water through irrigation and rain. The plots were harvested on October 3 and the yields calculated on the same basis as in 1953.

The yields and percentages of N and P of the averages from the different treatments for the two years are shown in the accompanying table. Statistical analyses of these data show that the 1953 yields were increased with application of nitrogen at rates up to

Sorghum grain yields and content of nitrogen and phosphorus associated with various applications of N and P_2O_5 in fertilizer experiment on Tobosa Flats, Tucumcari, New Mex., 1953 and 1954

Fertilizer applied in 1953, per acre		Yield per acre		Nitrogen content		Phosphorus content	
N	P_2O_5	1953	1954	1953	1954	1953	1954
Pounds	*Pounds*	*Bushels*	*Bushels*	*Percent*	*Percent*	*Percent*	*Percent*
0	0	36.8	30.4	1.30	1.24	.254	.322
40	0	44.4	25.0	1.32	1.15	.195	.290
80	0	45.4	32.7	1.45	1.18	.213	.322
120	0	50.2	36.1	1.64	1.23	.221	.323
160	0	55.7	38.2	1.72	1.41	.184	.298
0	40	41.3	36.1	1.19	1.11	.268	.363
0	80	40.2	29.7	1.21	1.11	.278	.338
80	40	52.0	31.2	1.48	1.21	.249	.331
160	40	58.5	33.1	1.78	1.21	.228	.355
80	80	54.0	38.6	1.35	1.16	.256	.331
160	80	54.4	35.6	1.64	1.17	.262	.384
160	80 + 80 K_2O	57.4	36.8	1.56	1.20	.231	.381
L.S.D	1%	12.6	N.S.	.23	N.S.	.053	N.S.
	5%	9.4	N.S.	.17	N.S.	.039	N.S.

80 pounds per acre. There was a decreasing response from additional nitrogen. Phosphorus gave a slight but not significant increase in the 1953 yield. Nitrogen content of the grain increased with each increment of nitrogen fertilizer added up to 120 pounds per acre. Phosphorus fertilizer had no effect on the percent in the grain. There was a highly significant increase in percent P in the 1953 grain from phosphorus fertilization; 40 pounds of P_2O_5 gave as much increase as did 80 pounds. All treatments receiving N were significantly lower in percent P than the check treatment.

The data from the 1954 crop show that there were no significant differences in any of the measures due to the 1953 treatments.

Wyoming

YIELDS OF IRRIGATED GRASSES ARE INCREASED BY NITROGEN FERTILIZER

Rulon D. Lewis, Laramie. --In a study at Pinedale, Wyoming, during 1953 and 1954, eight grasses were irrigated and fertilized with nitrogen at two rates. The eight grasses were common, Lincoln and manchar brome, orchard grass, timothy, intermediate wheat grass, meadow foxtail and Reed's canary grass. The nitrogen treatments were 80 and 160 pounds applied as ammonium nitrate; the material was broadcast in early May; there was a non-fertilized check. The grasses were irrigated at intervals of 12 to 14 days during the early part of the growing season, beginning about May 25, and at intervals of 7 days during the peak growing season during July. A total of 6 irrigations were made each year with the last about July 25. Water was applied 5 to 6 hours for each irrigation.

The grasses were grown on an immature, non-calcareous alluvium, consisting of igneous and quartzitic cobbles, gravel and sands mixed with small quantities of shale till washed from glacial moraines. The surface is a sandy loam with 4 percent organic matter, and an average pH of 5.2. The entire profile is weakly developed, varying from loam to coarse sandy loam alluvium of great depth. The subsoil has an average pH of 5.8. The average rate of water infiltration into the soil is approximately 0.91 inches per hour, and the water holding capacity is one-half inch to one inch per foot.

Climatic conditions during the study were average for the area.

Forage yields. All grass species responded to applications of nitrogen fertilizer, the average response being approximately two tons per acre for 80 pounds and about three tons per acre for 160 pounds. When 80 pounds of nitrogen were applied, Lincoln brome grass produced the most hay; and when 160 pounds were used, Lincoln and common brome grass were equal and highest with manchar brome second highest. The three brome grasses responded more to the heavy rate of nitrogen than the other grasses. When no nitrogen was applied, intermediate wheatgrass and manchar brome grass produced the highest yields. Applications of 80 pounds of nitrogen increased the crude protein percentage of six of the grasses. An additional 80 pounds of nitrogen increased the protein further in all grasses.

Crude protein. The highest percentage of crude protein was obtained from orchard grass for each nitrogen rate applied. The lowest percentage was from Lincoln brome grass where no nitrogen was used, from manchar brome grass for the 80-pound rate of nitrogen, and from intermediate wheat grass for the 160-pound rate.

Each rate of nitrogen gave highly significant increases in yield of crude protein produced per acre. Where no nitrogen was applied, the highest yield of crude protein was obtained from Reed's canary grass. When 80 pounds of nitrogen were applied, orchard grass produced the highest yield of protein, and when 160 pounds of nitrogen were applied, common brome produced the highest protein yield. The lowest yield was from Lincoln brome grass where no nitrogen was applied, from manchar brome grass for the 80-pound rate, and from timothy and intermediate wheatgrass at the 160-pound rate.

Calcium. With each increment of nitrogen, the calcium percentage of six of the grasses was increased. With the 80-pound rate there was an increase in calcium for each of the grasses. The 160-pound rate brought an increase for six of the grasses with no increase for two of them. The percentage of calcium was highest in orchard grass for all nitrogen treatments and lowest in meadow foxtail.

Phosphorus. The 80-pound rate of nitrogen caused increases, decreases, and no change in the percentage of phosphorus in the forage from all the grasses, compared with the no-nitrogen treatment. For the 160-pound rate compared to 80 pounds, there was an increase for seven of the grasses with no increase for one. Taking all nitrogen treatments into account the percent phosphorus in the forage was highest in orchard grass and lowest in manchar brome grass.

Dollar Returns. Returns per dollar spent for nitrogen evaluated on forage yields was highest for the 80-pound rate. When evaluated on crude protein yields, it was highest for the 160-pound rate.

Texas

NEW EQUIPMENT DEVELOPED FOR PLACING PHOSPHORUS BELOW SEEDS

M. E. Jensen, C. E. Van Doren, R. C. Reeder, Amarillo. --The desired placement of phosphorus fertilizer is below the seed where the roots of the seedling will have immediate access to the fertilizer. In order to place the fertilizer below the seed and still provide firm soil on which to drop the seed, special equipment has been used on the Model G Allis Chalmers tractor.

In this area, dry hot winds will quickly dry the soil down to the depth it has been worked. Therefore, if phosphorus is to be placed below the seed, a method of compacting the soil above the fertilizer must be provided. This has been accomplished by using a rubber tired press wheel directly behind the fertilizer furrow opener.

Hudspeth, at the Lubbock Experiment Station, has obtained better stands on cotton by using a rubber tire press wheel directly behind the seed furrow opener to press the seed into firm moist soil. This same principle has also been used in conjunction with the press wheel for compacting the soil above the fertilizer. A covering attachment is also used to cover the seed with about 1.5 inches of loose soil.

The complete unit has four furrow openers spaced 10 inches apart. By using the Texas 8-tray belt-type hopper, it is possible to broadcast nitrogen ahead of the furrow openers, place the phosphorus 2.5 inches or more below the soil surface, compact from one to 2.5 inches of moist soil above the fertilizer, place and press the seeds into previously compacted soil, and cover the seed with loose soil, all in one operation.

Planet Jr. equipment is being used for seeding uniformly, while the belt hopper is used for the fertility rates. This equipment will be used on wheat and alfalfa plots this fall and on grain sorghum plots in 1956.

Oregon

WHEAT YIELD RESPONSES TO FERTILIZER FEWER IN 1955 THAN IN 1954

Albert S. Hunter, Corvallis. --Yields have been tabulated on 49 fertilizer experiments with winter wheat in five Columbia Basin counties of Oregon. Considerable analytical work on the data remains to be completed.

It appears that some rates of nitrogen application increased wheat yields on 27 farms; all rates of N decreased yields on seven farms; and N had little or no significant effect on yield on nine farms. On farms where application of N decreased yields, this effect was of lesser magnitude from spring than from fall applications.

The 1954-55 cropping season was dryer than the 1953-54 season, suggesting the likelihood that on some farms, soil moisture may have been more limiting than nitrogen. Soil moisture and rainfall records now being summarized may throw further light on this suggestion.

This work will be continued in 1955-56 on approximately 40 sites with the fall application of fertilizer and sampling to be completed in October 1955.

SOIL STRUCTURE

Georgia

MAXIMUM BENEFITS FROM SAWDUST DEPEND ON ADEQUATE NITROGEN

H. C. Ukkelberg, Fleming.--Applications of sawdust made to improve the tilth of the soil may adversely affect crop yields unless adequate nitrogen fertilizer is applied. This is demonstrated in a study on a Bladen very fine sandy loam at Fleming. First season's results as measured in yield of cabbage are given in the table.

Yields of marketable cabbage per acre as affected by various rates of sawdust and nitrogen fertilizer applications, Fleming, Ga., 1955

Treatment per acre		Yield per acre
Sawdust	Nitrogen	
Tons	*Pounds*	*Pounds*
0	100	6,655
	150	5,895
	200	4,290
30	100	3,150
	150	6,065
	200	7,750
60	100	2,585
	150	3,830
	200	4,310

Note that the sawdust decreased yields sharply when only 100 pounds of nitrogen per acre were applied. When 150 or 200 pounds of nitrogen were applied, some yield benefits were obtained from the 30-ton application of sawdust. However, even the highest nitrogen rate was not sufficient to derive benefits from the 60-ton sawdust rate.

Variations in yield were due to differences in the numbers of marketable heads produced, not to differences in size of heads.

This study will continue to test further the value of sawdust. Should the use of sawdust prove economically feasible, a large supply of this waste material may be used to improve vegetable crop production in this area.

Texas

REDUCED CORN AND COTTON YIELDS MAY BE DUE TO SOIL COMPACTION

R. M. Smith, Temple.--Yield reductions probably due to soil compaction were noted in a fertilizer experiment.

Corn. A corn experiment showed no significant yield effect from 60-60-0 fertilizer. However, the following observations of yield reduction associated were made:

No compaction and no fertilizer	- 27 bushels per acre
No compaction plus fertilizer	- 26 bushels per acre
Compaction and no fertilizer	- 23 bushels per acre
Compaction plus fertilizer	- 21 bushels per acre

This corn was planted somewhat later than corn on adjacent experiments. The later planting gave lower yields, which is consistent with long time results at Temple, showing that corn yields correlate positively with June rainfall and negatively with June temperatures. Earliness helps to avoid these factors limiting yield.

Cotton. High variability of individual plots prevents 1955 results from being conclusive, but there was a tendency toward reduced yields where the soil was severely packed with a tractor when the soil was too wet for ordinary working. The compactions were performed before winter rebedding and were repeated on 3 different dates following spring rains. Average yields of seed cotton per acre were as follows:

Loose soil and no fertilizer	- 671 pounds per acre
Loose soil plus 60-60-0	- 697 pounds per acre
Compacted soil with no fertilizer	- 513 pounds per acre
Compacted soil plus 60-60-0	- 444 pounds per acre

On severely packed soil, the stand of cotton was poorer than on loose soil because the packed soil lumps were too large to make good initial contact with the seed. Stands averaged one plant every 3 inches on loose soil and one plant per 6 inches on packed plots.

Insect attacks and root rot were sources of variability as well as stand. Each treatment was replicated 6 times, but none of the averages shown are significantly different.

In 1954 severe packing lowered cotton yields from 243 to 209 pounds of lint per acre. The difference was statistically significant.

Bulk density and "varsol permeability index" determinations were used to show the influence of soil compaction on the soil. The varsol index is more sensitive to differences than bulk density measurements. Both measurements indicated that soil swelling and shrinkage during August rains (total rainfall for August was 13.5 inches) had essentially eliminated soil compaction differences induced during May.

CROPPING SYSTEMS

Texas

COTTON YIELD REDUCED BY WINTER COVER CROP

R. M. Smith, Temple.--In a field test, cotton following Austrian winter peas gave a yield of 833 pounds of seed cotton per acre whereas the cotton on land which had not had winter cover yielded 1,100 pounds. The difference was significant at the 5% level.

The peas in this trial were grown on the sides of the beds. When the peas were killed with subsurface sweeps on March 25, the soil where the peas were grown contained one inch less water than the soil where peas were not grown. The top growth of the peas amounted to 0.5 tons of dry matter per acre. This was left on top of the soil, and the beds for planting were not disturbed. The soil with and without the peas appeared to be in good physical condition. The soil is Houston Black clay. The cotton was grown following one year of phosphated oats with Hubam. Under the conditions represented, it appears that the one inch less water was more important to cotton yield than the leguminous residue containing about 30 pounds of nitrogen per acre.

A heavier growth of winter peas would have used more water. On very depleted soil the organic matter and nitrogen might be needed worse than the soil moisture. Cotton has not shown a definite response to fertilizer in various experiments on the Blackland Station.

Washington

CROP ROTATIONS ARE NOT CURE-ALL FOR SOIL-BORNE DISEASES

J. D. Menzies, Prosser.--There is a widely held belief that crop rotations can be used as an effective means of control for soil-borne plant diseases. This is not entirely true, and it is of value to crops specialists and conservationists to have a clear understanding of the limitations involved. If farmers are disappointed in their expectations of disease control they are likely to lose interest in rotations that are valuable for other reasons.

The following points should be kept in mind:

(1) Soil-borne disease is seldom if ever increased by a rotation that includes resistant crops, but the same diseases will probably increase under continuous cropping to a susceptible crop.

(2) It does not necessarily follow that a measurable decrease in disease level will result from rotation. The disease level in the soil may remain relatively constant through many years even without the susceptible crop.

(3) Rotations should be used as a preventative rather than a cure for plant diseases and for soil improving benefits. They are particularly effective in newly irrigated land if started before disease appears; but they are of only limited value in controlling a disease problem that is already serious.

(4) Many of our most important soil pathogens causing such diseases as potato scab, verticillium wilt, fusarium wilts, sclerotinia rots, and damping-off diseases are known as soil inhabitants--and are able to survive many years between susceptible host crops. These diseases are not often controlled satisfactorily by rotation and must be treated by other means.

(5) Chemical soil treatments are being developed to give effective control of this type of soil-borne disease. One of the most promising of these materials is penta-chloro-nitro-benzene (PCNB). This fungicide has proven to be very effective in controlling both scab and rhizoctonia in potatoes when worked into the soil before planting at the rate of 50 pounds per acre. Our data supporting this conclusion are presented in the following table.

Control of scab and rhizoctonia in potatoes by PCNB

Tillage following application	Application rate per acre	Tubers with more than 5% scab	Stems with rhiz. cankers	Tubers with rhiz.
	Pounds	*Percent*	*Percent*	*Percent*
Check.....	0	72.5	83.0	4.8
Rototilled.....	20	54.4	6.6	4.7
	40	37.5	0	1.4
	60	5.4	2.7	0
	80	6.6	1.9	.2
Disced.....	20	19.4	21.0	5.0
	40	14.4	0	1.8
	60	4.7	0	.4
	80	12.5	6.0	0

PCNB is still quite expensive, but costs of control could be materially reduced if suitable methods of strip application could be devised. Commercial use of PCNB on potatoes awaits establishment of residue tolerances by Pure Food and Drug.

MOISTURE CONSERVATION

Illinois

CLIMATIC ENVIRONMENT CONTROLS WATER REQUIREMENT OF CORN

D. B. Peters, Urbana. --Studies at the University of Illinois the past three years indicate that the amount of moisture required to produce a bushel of corn is controlled principally by the type of climatic season. These studies also indicate that the efficiency of water use is strongly conditioned by the soil temperatures when a cool growing season prevails. These conclusions are based on data from plots which were kept covered with polyethelene sheeting throughout the growing season.

Total water used and corn yield for covered plots, plots under natural rainfall, and irrigated plots, 1954 and 1955

	1954		1955	
	Corn yield per acre	Water used	Corn yield per acre	Water used
	Bushels	*Inches*	*Bushels*	*Inches*
Plots covered.....	45.5	6.6	96.5	7.0
Plots uncovered.....	92.4	12.9	81.0	13.8
Plots uncovered & irrigated.....	126.5	17.3	97.5	15.8

Comparing the data from the covered plots for the past two years, note that the yield of corn in 1955 was double that of 1954 but that during the two seasons essentially the same amount of water disappeared from the soil profile. The Urbana location was exceptionally hot and dry in 1954, whereas in 1955 it was cool during the early growing season and humid except for a two weeks' drought in August. It thus appears that no set

value can be given for the amount of water required to produce maximal yields and that the amount needed in a given climatic region can vary widely between seasons.

Kansas

DEEP TILLAGE FAILS TO INCREASE SOIL MOISTURE OR 1955 WHEAT YIELD

Paul L. Brown, Hays. --There are conflicting ideas and concepts of the value of deep tillage and so-called "third dimension farming." Some of the subsoils in western Kansas are compact and absorb water very slowly. It seems logical that deep tillage to open up the soil should result in better moisture penetration, less erosion and greater yields. Since increased water storage is one of the chief aims of deep tillage, the best time to use this tillage would appear to be at the beginning of a fallow period. An experiment was initiated during the fall of 1953 to obtain information on the effect of deep tillage on soil moisture storage during the fallow period and the resulting wheat yields.

The experiment was located on an area of Munjor silty clay loam that had produced a milo crop in 1953. This soil has a low water intake rate after dry weather cracks close. The milo was combined, leaving stubble 18 to 20 inhces in height. Fall tillage, initiating the fallow period, consisted of the following 5 treatments:

(a) Subsoil tillage, 24 inches deep.
(b) Sweep (40-inch V blade), 18 inches deep.
(c) Heavy-duty chisel tillage, 12 inches deep.
(d) V blade (7-1/2 feet wide), 6 inches deep.
(e) No fall tillage.

The surface 2 feet of soil was extremely dry and the tillage did a good job of shattering the soil to the depth of tillage. The subsoiler and sweep were used at 4-foot intervals. The heavy duty chisels were spaced at 18-inch intervals.

After the initial fall tillage (1953) the land was uniformly fallowed in 1954, implements being a duckfoot cultivator, blade and rod-weeder.

Soil moisture. The dates and results of the soil moisture samplings that were taken to a depth of 6 feet on 5 dates are given in the table that follows:

Available moisture in soil (Munjor silty clay loam) associated with various types of initial tillage for fallow, Kansas, 1953-1955

Initial tillage		Inches of available water* by dates				
Type	Depth	10-31-53	2-6-54	6-24-54	9-11-54	7-11-55**
	Inches					
No tillage....	----------	1.90	5.29	7.75	7.39	2.82
Blade.....	6		4.11	7.12	6.76	2.58
Chisel.....	12		4.41	6.18	6.86	2.44
Sweeps.....	18		4.53	8.07	7.87	2.77
Subsoil.....	24		4.11	7.12	6.84	2.74
Average...			4.49	7.25	7.14	2.67

*Differences in available water contents were not significant statistically.
**After wheat harvest sample.

Differences in soil moisture due to tillage treatment were not significant at any of the sampling dates. Precipitation during the entire fallow period measured 19.56 inches, but only 5.24 inches was stored in the soil. The storage efficiency for the entire fallow period was 27%. Storage efficiency varied from 71% for the initial period to a slight soil moisture loss during the last interval of the fallow period.

Infiltration rates. Wheat was drilled September 27 and redrilled on October 6. Hanks and Thorp (see Quarterly Report of March 1955) measured the infiltration rate on the control, sweep, and subsoil plots as follows:

No tillage	Subsoiler or subsurface sweep
1.75 in./hr.	2.06 in./ hr.

Subsoiling increased the average infiltration rate the first hour but the differences were not significant at the 5 per cent probability level.

Visual observations. During the infiltration test, a trench was dug in an effort to locate the old subsoiler marks. The only evidence of the subsoiler was a soft area where the subsoiler foot had pushed through the soil. There was no visible evidence above or laterally from the subsoiler mark to indicate its effect. The soil above the subsoiler mark was compact and difficult to dig.

Yields and test weights. Wheat yields were not increased by deep tillage at the beginning of the fallow period. Any effect of deep tillage appears to have been obliterated at the present time (fall 1955) but the plot locations are recorded, and crop growth and soil moisture conditions will be checked for at least one more year.

Wheat yields and test weights associated with various types of initial tillage for fallow on Munjor silty clay loam, Kansas, 1955

Initial tillage		Yields per acre	Test wts. per bushel
Type	Depth		
	Inches	*Bushels*	*Pounds*
No tillage.....	----------	39.1	62
Blade.....	6	37.3	62
Chisel.....	12	38.0	62
Sweeps.....	18	39.5	62
Subsoil.....	24	39.4	62

Hays history. Subsoiling has been included in seedbed preparation for the various crops at the Hays Station since 1908. Subsoiling to a depth of 14 inches in conjunction with plowing for two consecutive years out of every four as seedbed preparation for continuous wheat increased yields 2.7 bushels per acre over plowing alone but produced the same yield as listing for seedbed preparation. A similar combination of subsoiling and plowing increased milo and kafir grain yields about 2 bushels per acre above other methods of seed bed preparation.

The range of applicability of these results is unknown but probably will vary with years and soils.

Kansas

WINTER WHEAT SHOWS AMAZING DROUTH RECOVERY ABILITY

Paul L. Brown, Hays.--Winter wheat was subjected to severe drouth stress during the spring of 1955 over a large area of Kansas. By the first of May, large acreages showed severe drouth symptoms and stunted growth. Many leaves were bluish green

and curled. Some leaves were actually dead, others were drying up, and in some cases the wheat had a dry-hay odor. The wheat looked as though it had been damaged permanently and that recovery was all but impossible at this late date when wheat normally starts to joint.

Water was applied to small plots of typically drouthy wheat on May 2 so that its drouth recovery ability could be observed.

Three rates of water application were made with a 1/1,000 acre portable, sheet-metal dike. Rates of application corresponded to 3, 5 and 7 inches of water. Four days after application, the 3-inch water application had penetrated 12 inches, and the 5- and 7-inch applications had penetrated 20 and 30 inches, respectively.

The wheat responded quickly and within one week was dark-green and growing well. By the end of May, the wheat that had received 3 inches of water showed some evidence of drouth stress, but the 5- and 7-inch plots showed none. Rainfall measured 2.48 inches during May. This would indicate that the wheat used more than 5 inches of moisture during the month.

Wheat on the watered plots grew considerably taller than the surrounding wheat and ripened more slowly. Grain yields, straw yields and test weights were as follows:

Water added	Grain yields per acre	Straw yields per acre	Test wts. of grain per bushel
Inches	*Bushels*	*Pounds*	*Pounds*
0	5.4	810	57.0
3	13.7	1,360	58.0
5	22.9	2,150	58.5
7	24.0	2,200	58.5

On the 3-inch-watered plot each inch of water added produced 2.8 bushels of wheat per acre. The 5-inch-watered plot produced 3.5 bushels of wheat per acre per inch of water added. Seven inches of water produced 2.7 bushels of wheat per acre per inch of added water.

Unwatered wheat produced 150 pounds of straw per bushel of wheat. The plots that received 3, 5 and 7 inches of water produced a bushel of wheat with each 99, 94 and 92 pounds of straw, respectively.

The significance of this experiment is that winter wheat will recover from severe drouth stress even as late as the early jointing stage if good rains come. However, the probability of receiving 5 inches or more of rain in May anywhere in the Great Plains area is not great, and as pointed out above, the wheat in this experiment used more than 5 inches of water in May.

The soil involved was Yocemento silty clay loam (tentative), which is similar to Hastings except that the lime zone occurs at a much shallower depth.

This was only one year's data on unreplicated plots, but the results were unmistakably striking. There appears to be no reason similar results would not be obtained under similar circumstances over most of the winter wheat belt.

EXTREME VARIATIONS IN PRECIPITATION SEEN IN WOODWARD DATA

L. F. Locke, Woodward.--Experience has shown that distribution of precipitation is often more important than the total amount. It is not the average precipitation that creates costly situations; rather it is the extremely low precipitation period or the highly intense rainfall of short duration that causes severe damage from drouths and runoff. The effects of low rainfall periods are further intensified by evaporation losses from small amounts of rainfall during such periods.

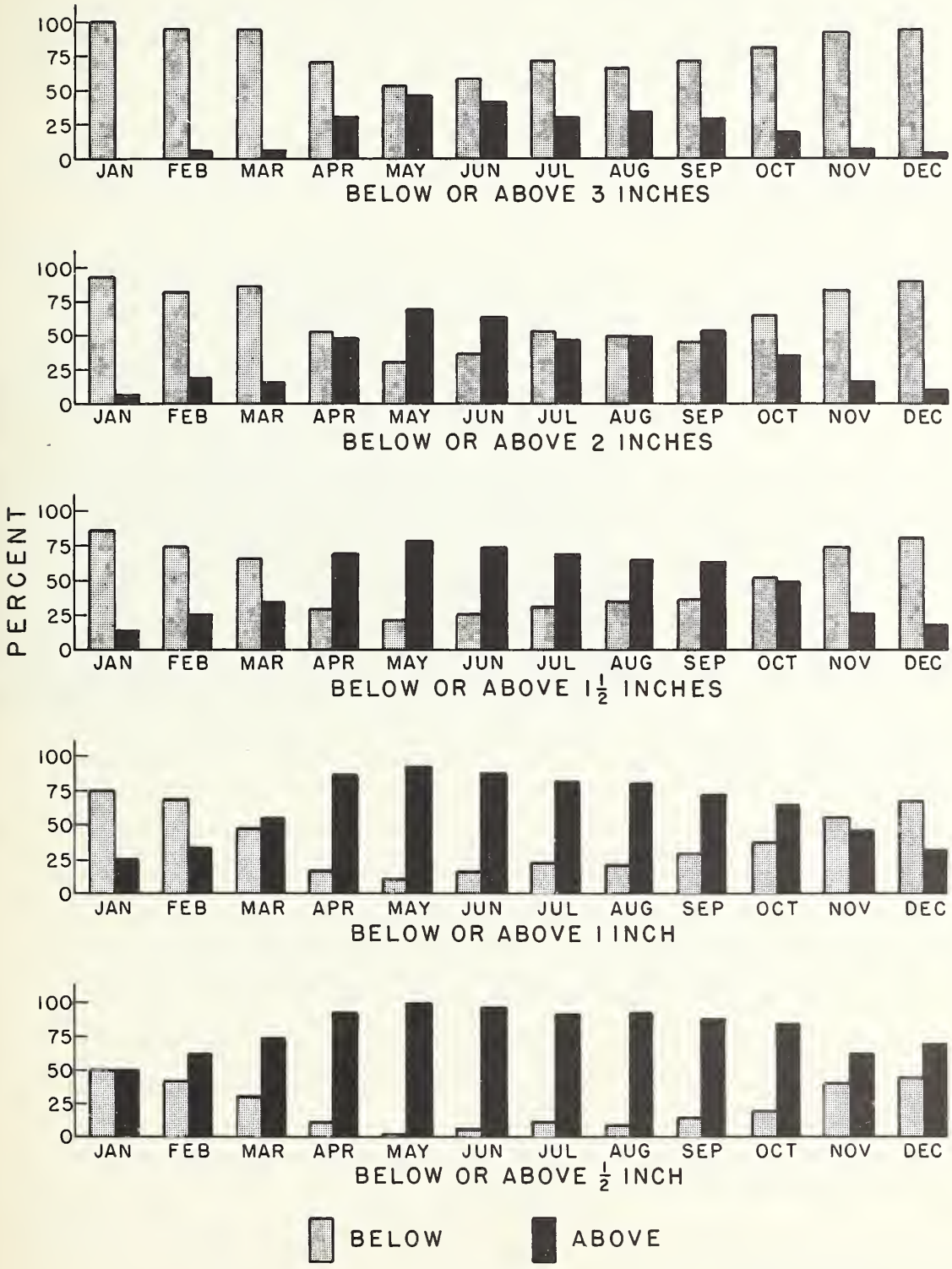
The data in the accompanying table show the extreme and average monthly precipitation of Woodward for the 1885-1954 period. The lowest annual precipitation at this location was 10.35 inches in 1886, the highest was 41.22 inches in 1941, with the average annual precipitation being 22.94 inches.

Summary of monthly extreme and average precipitation for the period 1885-1954, Woodward, Okla., and vicinity

Month	Precipitation		
	Lowest	Highest	Average
	Inches	*Inches*	*Inches*
January	0.0	2.89	.69
February	0.0	8.09	.99
March	0.0	4.31	1.19
April	0.01	6.83	2.40
May	0.06	10.00	3.45
June	0.0	10.26	2.93
July	0.0	11.88	2.44
August	0.03	8.18	2.57
September	Trace	9.33	2.28
October	0.0	11.99	1.99
November	0.0	9.54	1.17
December	0.0	3.52	.83

The data illustrated in the accompanying charts show the expected frequency of low and high precipitation by months. These data are based on a 68-year period, 1885-1952.

Percentage of time precipitation for each month has been below or above specified levels, Woodward, Okla., and vicinity in 68 years, 1885 - 1952



Texas

NEW WAY TO HOLD WATER ON TERRACED FIELDS TO BE TRIED

C. E Van Doren and A. W. Zingg, Amarillo. --In the spring of 1955, a series of conservation benches were constructed on terraced land with a slope of from 1 to 2.5 percent. The level benches were constructed on the lower third of terrace intervals with a 5-foot vertical spacing, leaving the upper two-thirds undisturbed. Adjacent to these conservation benches are two terrace systems on the same slope with 2.5 foot vertical intervals. One system has level closed-end terraces, and the other has graded open-end terraces.

A wheat-sorghum-fallow rotation will be used on all areas in the level and graded terrace systems. The conservation benched plots will be cropped as follows: Continuous sorghum on the level bench and a wheat-sorghum-fallow rotation above the bench, alfalfa on the bench and a wheat-sorghum-fallow rotation on the slope, and continuous grain sorghum on both the bench and slope.

In this experiment a radical departure from the usual terrace system has been made in an attempt to retain the water- and erosion-control benefits of terraces and at the same time hold all surface runoff on the field and utilize it for crop production.

Texas

CORN YIELDS WELL IN SPITE OF EARLY FLOODING

R. M. Smith, Temple. --Corn in a field where water stood during May yielded 72 bushels per acre. Yields of corn from nearby areas not inundated in May yielded only about half as much grain. The corn plants that stood in water became very yellow and unhealthy in appearance, and oxygen diffusion measurements indicated that the oxygen supply in the soil was low. However, the crop was apparently aided enough by the extra water to more than overcome the damage done by the temporary excess of water.

Utah

IMPERVIOUS CATCHMENT BASIN COLLECTS MORE STOCKWATER IN DESERT

C. W. Lauritzen, Logan. --Water for livestock limits the utilization of forage in many low-rainfall areas of the west. The precipitation that occurs in these areas generally come in small amounts and at irregular intervals. When it falls, the soil is normally dry and, except in the case of the infrequent heavy storm, no runoff occurs.

Recognizing this problem, consideration was given to the surfacing of a catchment basin with a water tight nonabsorbent material. Experience with polyethylene film for canal and reservoir lining, led to a test of this material as a catchment basin covering.

A dam was constructed across a natural drainage in the fall of 1954, and an area of about one acre above it was graded and fenced. Just ahead of the dam, an area approximately 100 x 100 feet was deepened to form a pond and provided with a pipe line drain leading to a watering trough on the other side of the ridge outside the fenced area.

A black polyethylene covering for the graded area was fabricated and shipped in sizes of 190 feet by about 14 feet and installed in April 1955. Each width was provided with a 1-foot tail along the center line for burial to anchor the film to the ground. The lengths of film were joined together by heat sealing.

Rains since the installation have resulted in the collection of considerable amounts of water, demonstrating that the approach is sound.

A most unexpected and damaging development--holes pecked by curious ravens or crows--appears to be the most serious factor limiting the effective use of polyethylene for catchment areas. The thickness of the film used was 8 mils. The study is being continued with other tests planned to evaluate different materials and construction practices.

TILLAGE AND CULTURAL PRACTICES

Maryland

FIRST YEAR'S RESULTS WITH SUBSOILING LOOK PROMISING AT BELTSVILLE

C. S. Britt, C. S. Slater, W. C. Hulburt and C. W. Gantt, Jr., Beltsville.--Productivity of Beltsville silt loam is restricted by dense subsoil and impeded drainage. Subsoiling to a depth of 22 inches improved the growth of corn on this soil in 1955.

Tool bar subsoiler and fertilizer attachment used for deep placement of fertilizer on plots.

The plots were subsoiled in the fall of 1954. At that time the ground was dry enough to fracture satisfactorily. About half of the subsoil between plow depth and 22 inches was loosened when the land was chiseled on 42-inch spacings. Other plots were left without subsoiling as checks.

All plots were fertilized with 1,500 pounds of 10-10-10--300 pounds being drilled at time of planting with a conventional split-boot depositor on the planter and the remaining 1,200 pounds used in some combination of deep placement with surface application. The deep-placed fertilizer was put down behind the shank of the subsoiler. Surface application in excess of the row application was made with a fertilizer drill.

The land was spring plowed out of 2 year old sod and fitted by disking and harrowing. Corn was planted May 11. By July 7, corn on subsoiled plots was about 10% taller than on plots not subsoiled. Fertilizer placement made little or no difference in corn height.

Yield data are shown in the table that follows. These data show an increase for subsoiling but very little additional increase for placing part of the fertilizer in the subsoil.

Corn yields as affected by subsoiling and deep placement of fertilizer
Beltsville, Md., 1955

Fall tillage	Treatments			Corn yield per acre
	Lbs. 10-10-10 placed deep	Lbs. 10-10-10 drilled	Lbs. 10-10-10 in row	
				Bushels
Not subsoiled...	0	1,200	300	51.5
Subsoiled.....	0	1,200	300	61.0
Subsoiled.....	300	900	300	62.0
Subsoiled	600	600	300	63.7

Subsoiling investigations will be continued and extended for the 1956 crop year to Ashby shale in Western Maryland and to Penn shale in Northern Virginia.

Iowa

MULCH TILLAGE CUTS COSTS, REDUCES BLOWING ON SANDY SOILS

W. E. Larson, Ames.--Experiments have been underway since 1953 on the Sand Experimental Field near Independence to develop methods of mulch or subsurface tillage for corn. Three years of data comparing mulch tillage with conventional plowing methods are now available and are tabulated below.

Corn yields from mulch tillage and plowing on Dickinson sand

Tillage treatment	Yields per acre			
	1953	1954	1955	Average
	Bushels	*Bushels*	*Bushels*	*Bushels*
Plowing.....	92.2	27.6	56.6	58.8
Mulch tillage.....	91.2	36.7	56.4	61.4
	Differences not significant at 5% level.			

Notice that corn yields have been equally as good from mulch tillage as from plowing. This was true in 1953 when yields were over 90 bushels per acre and also in the dry years of 1954 and 1955.

Here are the operations used in the mulch tillage system:

The land is first "swept" with large subsurface sweeps. The sweeping may be done a few weeks before corn planting or may immediately precede planting. The sweeps are usually from 20 to 45 inches from heel to heel and loosen the soil 3 to 6 inches deep. In some cases double sweeping may be desirable. Sweeping is followed by a light discing immediately before planting. Discing firms the soil, ties down the trash, and eliminates small weeds. Planting follows and is done with a conventional planter equipped with furrow openers. Planting the corn in furrows places the seed in deep moist soil and enhances weed control; the rough surface helps control blowing.

Cultivation can be done with conventional equipment. Corn in these experiments has usually been rotary hoed once and cultivated twice. Larger than normal cultivator sweeps will aid in allowing the residues to pass through.

Corn in the test reported here was grown following oats and vetch in a corn-oats (vetch) rotation. In other mulch tillage experiments at the Sand Experimental Field, corn has been grown successfully following corn and alfalfa.

There are many thousands of acres of sandy land in Iowa where wind erosion is a severe problem. Soil blowing removes fertile topsoil, depositing it in roadways, along fence lines and in other protected areas. Blowing also "cuts off" or "blows out" small plant seedlings, reducing or completely eliminating crop stands. Advantages of mulch tillage include lower tillage costs and leaving crop residues on the surface for wind erosion control and moisture conservation.

CONSERVATION PRACTICES IMPROVE CORN PRODUCTION

Orville E. Hays, LaCrosse.--Recent work at LaCrosse has been directed at the development of methods of controlling runoff and erosion in corn and use of corn as a nurse crop for legumes and grasses. Need for this program has been emphasized by the extremely high soil and water losses from small grain on plowed ground following corn. Eleven years of data show that oat land lost 1.8 times as much runoff and 2.3 times as much soil as corn following hay. Cultivation of corn land sufficiently breaks down the improved soil structure, built up during the hay years, so that a storm of even moderate intensity and amount occurring during the spring and early summer will result in high soil losses from grain land on the steep Fayette silt loam soils at this station.

One of the most effective methods found for reducing soil losses from spring grain was to have grain following hay. Oats following corn lost 3.4 inches of runoff and 28.6 tons of soil per acre, but oats following hay lost only 1.4 inches of runoff and 5.8 tons of soil per acre.

Interseeding in corn with a packer type seeder has been under study for four years in which seeding was done in corn rows with 40-inch, 60-inch, 80-inch and skip-row spacing. Our data indicate that a 60-inch row results in the least reduction in yield of corn and lets sufficient light in to establish good stands of hay.

Various methods of seeding have been under study, such as the cultipacker seeder, the one row drill, and broadcast with the whirlwind seeder. Needless to say, in a year like 1954 with good rainfall distribution and adequate soil moisture, most any method produces good yields. However, in 1955, with precipitation 7 inches below normal and soil moisture depleted by the corn, band seeding with a cultipacker was the only method producing good stands of legumes. Where weeds were a problem, clipping saved the legume stands. Where not clipped, the legume seedlings did not survive.

University of Wisconsin Photos

Tractor track planting shows promise as a way of cutting down on runoff and erosion and on the cost of producing corn. In tractor track planting, the land is plowed 8 to 10 inches deep within two days prior to planting of corn. No other seedbed preparation is used. The tractor wheels compact the furrow slice for the planter shoe. We have found less weed competition under these conditions than where the normal seedbed is prepared. On the Fayette silt loam at LaCrosse stand counts and yields of corn after the tractor track planting are as high as and frequently higher than those following conventional planting.

In 1955 a rain after planting but prior to cultivation produced no runoff from tractor track planting but resulted in 0.30 of an inch of runoff and 1.6 tons per acre of soil loss where normal planting had been done. A storm which occurred after one cultivation produced five times as much runoff from the normal planting as from the wheel track planting.

A combination of wheel track planting and interseeding is a promising soil and water conservation tool. The land is in hay until early June. It is in a rough absorptive condition until the last of June. Cultivation is delayed until the corn is 8 to 10 inches tall. Then the area is interseeded by the first or second week in July.

We are continuing an intensive program of research designed to evaluate and improve these practices.

Texas

GRASS SURVIVAL FROM SPRING PLANTING GREATER THAN FROM FALL PLANTING

W. C. Moldenhauer, Big Spring. --Spring seeding of grasses was found to be far superior to fall seeding under the conditions of this experiment (cover crop grown during the summer, subsurface tilled, and grasses seeded August 15 compared with seedings made the following spring.) The difference was not nearly so great when the land was fallowed without growing a sorghum crop. The advantage of this fallow did not carry over to the following spring, however, as shown by the last column of the accompanying table compared to the third column. With average fall precipitation the lack of stand survival following the sorghum crop probably would not have been so pronounced.

Winter survival of fall seeded grasses was uniformly very poor. As to the switchgrasses, only a few plants survived in the entire 10-acre block. Survival rates of King Ranch bluestem and blue buffelgrass were somewhat lower than those of the lovegrasses and gramas. Survival of the spring seeding was about the same for all species except King Ranch bluestem and blue buffelgrass, which survived less well. Nomad alfalfa survived in spots on the fall seeding, but none was found on the spring seeding.

Survival ratings* of 11 grasses and one legume seeded in fall and in spring following sorghum stubble and summer fallow, Big Spring, Tex.

Grass species	Fall seeding		Spring seeding	
	After crop of sorghum, stubble-mulched just before seeding	After fallow (check plot)	After sorghum crop grown previous summer	After fallow previous summer (check plot)
	Index No.	*Index No.*	*Index No.*	*Index No.*
Weeping lovegrass	1.3	4.0	3.5	4.0
Lehman lovegrass	1.0	2.0	3.5	4.0
Wilman lovegrass	0.8	3.0	2.5	4.0
Boor lovegrass	1.3	2.0	3.4	4.0
Sand lovegrass	1.5	1.0	2.9	4.0
Common switchgrass	0.1	0	2.1	0
Blackwell switchgrass	0.1	0	2.6	0
King Ranch bluestem	0.6	0	1.5	3.0
Blue grama	1.0	1.0	2.5	4.0
Blue buffelgrass	0.5	1.0	0.9	1.0
Sideoats grama	1.0	3.0	3.2	4.0
Nomad alfalfa	0.6	0	0	0

*Key: 0 - no plants
1 - Very few isolated plants
2 - numerous isolated plants
3 - small areas with good stand
4 - large areas with good stand
5 - solid stand

Idaho

FALL DISKING FOR STUBBLE REDUCTION CUTS 1955 WHEAT YIELD

Francis H. Siddoway, St. Anthony.--Fall disking is quite commonly used in this dryland area where there are large amounts of straw and stubble to facilitate later plowing, rod weeding and drilling. While fall disking does accomplish the stubble reduction job fairly well, the effect of the standing stubble as a mechanical snow trapping and holding device is altered adversely. In areas subject to snow drifting, stubble height often governs winter snow cover depth and consequent soil moisture intake. Where moisture is a limiting factor in crop production, any cultural practice which helps conserve moisture is of prime consideration.

Yields from the fall disking treatment, regardless of plowing method, were significantly lower than from the other preparatory tillage treatments. No other preparatory tillage treatment resulted in a significant yield difference.

If stubble reduction is necessary, this operation should be delayed until the spring following harvest.

Yields were lower from moldboard-prepared fallow than from other methods of fallow preparation, though not significantly so.

Yields of winter wheat after various plowing and preparatory tillage treatments, St. Anthony, Ida., 1955

Plowing treatment	Yield per acre where preparatory tillage was--					Average yield from plowing treatments*
	Rotary subsoiled fall 1953	Chiseled fall 1953	Disked fall 1953	Disked spring 1953	Check plot	
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
Moldboard.....	35.5	34.0	31.1	34.2	33.3	33.6
Sweep.....	36.1	36.8	31.3	36.2	36.7	35.4
Modified moldboard.....	35.3	33.2	32.4	34.7	34.3	34.0
One way disk.....	37.2	34.6	32.4	34.5	36.3	35.0
Offset disk.....	35.7	37.1	34.8	36.3	35.3	35.8
Average yield from preparatory tillage treatments*.....	36.0	35.1	32.4	35.2	35.2	34.8

*Least significant differences: For plowing treatments--none; for mean yields from preparatory tillage treatments--1.9 bushels at 5% level and 2.6 bushels at 1% level.

SOIL AND WATER MANAGEMENT--GENERAL

Florida

WATER TABLE O.K. AT 20-30 INCHES FOR RAMIE, 18-42 FOR CORN

Alan S. Craig, Belle Glade.--Yield and water consumption data for ramie, a perennial fiber crop, and field corn, two important agronomic crops in the Everglades, grown in the 1/1000 acre lysimeter tanks at the Everglades Experiment Station are shown in the tabulation that follows.

Water consumption observations were terminated by lodging of the corn by high winds and by excessive flooding of both crops by heavy rains in June.

These tests show that yields of ramie can be maximized by growing the crop at a water table depth of from 20 to 30 inches and that Corneli 54 field corn, a promising new variety, yields well at a wide range of water table depths from 18 to 42 inches.

Everglades Experiment Station Lysimeter Tank Studies
Ramie 1954-1955

Variety--PI 87521 (Commercial).
Soil--Everglades peat.
Fertility--Uniform, commercial fertilizer application based on results of soil tests.
Planted--August 6, 1954, 3-foot rows, 6-inch spacing.
Harvested--June 17, 1955 (first of normal three harvests per year).
Class A evaporation for crop period--55.3 inches.

Water table depth	Plant height	Total green yield per acre	Fiber in total green yield	Yield of decorticated fiber per acre	Water consumption by crop
Inches	*Inches*	*Pounds*	*Percent*	*Pounds*	*Inches*
12	72	16,200	3.05	494	52.4
21	86	26,300	3.60	947	54.9
30	85	24,900	3.42	852	50.2

Planting lost 6/23-6/25/55 by flooding.

Everglades Experiment Station Lysimeter Tank Studies
Field Corn 1955

Variety--Corneli 54.
Soil--Everglades peat.
Fertility--Nearly uniform, specially mixed fertilizers used to give uniform recommended level.
Planted--March 9, 1955, 3-foot rows, 12-inch spacing.
Harvested--July 19, 1955 (131 days).
Class A evaporation--21.8 inches (98 days)*.
--28.8 inches (131 days).

Water table depth	Stalks produced	Ears produced	Weight of ears	Lodged stalks	Water consumption for first 98 days*
Inches	*Number*	*Number*	*Pounds*	*Number*	*Inches*
18	16	16	7.7	10	17.4
30	15	13	6.2	7	14.4
Random	13	13	5.4	9	(Tank Leaks)
18	13	12	6.5	0	16.5
30	17	14	8.5	4	15.2
42	14	12	8.0	3	14.6

*Water consumption after 6/15 (98 days) not typical as a result of severe lodging and flooding.

South Dakota

ROW SPACING AFFECTS GRASS SEED PRODUCTION

Lawrence O. Fine, Brookings. --The seed production performance of four grasses was observed on row-planted plots started in 1954. The grasses were smooth brome (Bromus inermis. var. Homesteader), tall wheatgrass (Agropyron elongatum), Ree wheatgrass (Agropyron intermedium) and crested wheatgrass (Agropyron cristatum. var. Nordan). Russian wild-rye (Elymus junceus) was also planted in the experiment but failed to produce any seed in 1955.

The grasses were planted in rows 9, 18 and 36 inches apart; row sections 50 feet long were harvested, threshed and cleaned for yield determination. The results of 1955 are shown below.

Seed production of four grasses in three row spacings, South Dakota, 1955

Species	Pounds of seed produced per acre*			
	In 9 inch rows	In 18 inch rows	In 36 inch rows	Mean
Brome.....	302	362	237	301
Tall wheatgrass.....	257	266	190	238
Ree wheatgrass.....	321	294	201	272
Crested wheatgrass.....	519	488	317	441
Mean.....	350	353	236	

*L.S.D. (.05) for species, 82 lbs.; for spacing, 79 lbs.

The interaction of spacing x varieties proved to be non-significant this year.

Rows spaced at 36 inches were definitely inferior to those at 18 inches and 9 inches in this first year of production. Performance in later years will be measured to observe the progress of "sod-binding" and the effect of nitrogen applications.

Nebraska

STUDIES EXPANDED TO AID CONSERVATION NURSERY

Lionel Harris, Mitchell. --Studies of plants for soil, woodland, wildlife and range conservation are being expanded and intensified to back up the nursery work which will be carried on at the Scotts Bluff Experiment Station under cooperative agreement between the Nebraska Agricultural Experiment Station and the Soil Conservation Service. Dr. Ernest Jackson of the Agronomy Department, College of Agriculture, Lincoln, has been employed as project leader.

The studies will cover influence of cultural methods and fertilizers on seed production of selected conservation plants as well as determination of compatibility of forage species in mixtures and the breeding and selection of strains for specific conservation purposes.

Late in August approximately four acres of Western wheatgrass and four acres of the Amur strain of intermediate wheatgrass were seeded. Both grasses were seeded in rows of different widths for study of the influence of cultural practices on seed production. Fertilizer will be added to some plots next spring. A rod-row nursery including many grasses and legume plants will be established next spring.

Virginia

RUNOFF RATES AND YIELDS FROM LIMESTONE SOILS ARE LOW

James H. Lillard and James B. Burford, Blacksburg.--The highest flood peaks and runoff yields from three Bell Creek watersheds located near Staunton are given in the following table:

Watershed	Dates	Rainfall (per hour)			Surface runoff		Antecedent rainfall	
		Intervals		Total	Peak rate (per hr.)	Total	Dates	Amount
		15 min.	30 min.					
		Inches	*Inches*	*Inches*	*Inches*	*Inches*		*Inches*
W-I	4-13-49	2.88	2.12	1.71	0.39	0.35	4-13-49	0.36
(0.61	6-20-49	4.48	3.44	1.84	0.15	0.12	6-15,18-49	4.81
Sq. Mi.)	10-15-54	1.20	1.10	5.15	1.32*	1.71*	9-20-54	0.64
W-II	4-13-49	1.84	1.30	1.11	0.25	0.24	4-13-49	0.57
(3.80	6-20-49	4.48	3.44	1.60	0.28	0.31	6-15,18-49	4.81
Sq. Mi.)	7-15-49	3.44	1.98	1.00	0.13	0.15	7-14-49	0.88
W-III	4-13-49	1.48	0.96	0.91	0.12	0.15	4-13-49	0.57
(9.60	6-28-49	1.48	1.28	1.00	0.14	0.20	6-20-49	1.76
Sq. Mi.)	7-25-51	2.32	1.86	2.52	0.13	0.23	7-24-51	1.25

*Peak exceeded limit of established rating curve. Values shown were extrapolated.

The soils are of limestone origin with silty clay loam as the predominating texture. More than half of each watershed is in pasture; an additional 30 percent is in cultivation and about 15 percent is in forests. Slopes up to 45 percent occur in each watershed, but more than three quarters of the areas are in the 6 to 25 percent range. Likewise, more than 75 percent of the areas are in land capability classes III and IV and about 18 percent in class II.

The erratic runoff behavior of these limestone watersheds is emphasized by the storm of October 15, 1954 (Hurricane Hazel) which produced a peak rate beyond the limit of the rating curve for the station on the smaller W-I Watershed (see table) while further down stream at W-II and still further down at W-III the peak rates were 0.0198 and 0.0853 inches per hour, respectively. Rainfall was nearly uniform over all three watersheds.

Ohio

DEW REDUCES DEMAND ON SOIL MOISTURE

L. L. Harrold and F. R. Driebelbis, Coshocton.--The amount of water added to the earth's surface as dew totals roughly 10 inches annually at this location. Weighing lysimeters provide a means of evaluating evapo-transpiration (ET) as well as condensation and absorption (CA). The latter, commonly termed dew, varies with the season. Periods of hot days and cool nights are favorable for dew formation. Data for August, 1951, from lysimeter Y103A typifying this phenomenon appear in the table below.

Daily dew values for August, 1951, Lysimeter Y103A

Date	Dew	Date	Dew	Date	Dew
	Inches		*Inches*		*Inches*
1	0.02	12	0.06	23	0.06
2	.03	13	.07	24	.06
3	.01	14	.06	25	.06
4	.02	15	.05	26	.05
5	.03	16	.05	27	.03
6	.01	17	.08	28	.04
7	.01	18	.05	29	.05
8	.04	19	.06	30	.06
9	.05	20	.05	31	.02
10	.04	21	.05	Total	1.39
11	.06	22	.06		

Rainfall for August, 1951, was only 0.55 inch. This followed July rainfall of 2.93 inches. Both months were deficient in moisture. Contrary to expectation, corn plants of a prospective 80-bushel yield did not wilt during the very dry August. It is believed that dew was a major factor in providing enough water for the crop. Small amounts of water supplied every evening met the need.

Lysimeter records show increased weight from dew formation usually beginning about 3 or 4 o'clock in the afternoon. Increases in weight often continue until midnight. The time when weight increases begin appears to correspond to that when the temperature of the air at the ground surface drops below that of the 30-inch height. These are the only air-temperature heights being observed.

Although the dew is generally evaporated before noon, records show that the net effect is to conserve soil moisture. During the period of dew evaporation, there is little or no water removed from the soil by vegetation.

Nebraska and various other States

RUNOFF PUBLICATION BEING PREPARED

Ludwig L. Kelly, Hastings, Nebr.--Agricultural planning and operations agencies have expressed an urgent need for water yield and other hydrologic information from small agricultural watersheds. In response, project staffs of the Watershed Hydrology Section are undertaking a comprehensive analysis of all accumulated data and are preparing, as an initial publication, a summary of rainfall and runoff from the experimental agricultural watersheds throughout the country.

The report will include information on about 365 watersheds at 60 locations in 27 states. All experimental agricultural watersheds having records long enough to be of significance will be presented. Types of watersheds being included are:

1. Experimental watersheds such as those at Coshocton, Ohio; Waco, Tex.; Hastings, Nebr.

2. Watersheds at former SCS demonstration projects such as Freehold, N. J.; Muskogee, Okla.; Dayton, Wash.

3. Watersheds at State Agricultural Experiment Stations such as College Park, Md.; East Lansing, Mich.

4. Watersheds at Soil and Water Conservation Experiment Stations such as Watkinsville, Ga.; Zanesville, Ohio; Mexican Springs, New Mex.

Basically, this initial publication will include, for each watershed, a summary of monthly amounts of precipitation and runoff and a concise description of the watershed. The material for each watershed is being condensed to two pages. The publication will be in loose leaf form. Plans are to have part of the material printed and ready for distribution by December 31, 1955 and the balance by June 30, 1956.

Many persons in other agencies and in other Sections of the Branch are providing invaluable assistance in helping to locate and prepare some of the records for publication. Their help is gratefully acknowledged.

New Mexico

HEAVY RAINS HIT ALAMOGORDO CREEK EXPERIMENTAL WATERSHED

R. B. Hickok, Albuquerque.--Three important runoff-producing storms occurred on the Alamogordo Creek Experimental Watershed this season. The first one, on July 19, had more than 4 inches of rainfall at its center but was spotty with high intensities recorded at several points and practically no rain at other places in the watershed. This was followed on July 21 and 22 by a storm that amounted to over 5 inches at its center and averaged about 2.7 inches over the entire watershed of 67 square miles. The third storm occurred on September 20, but records of it have not yet been received.

The storm of July 21-22 resulted in unexpectedly high runoff and caused considerable damage to the principal gaging station as described and illustrated in the Hydraulics section of this report. The damaged flume is now being repaired and rebuilt with a larger capacity.

Runoff in relation to point rainfall. The July 21-22 storm was centered near the outlet of the watershed, and maximum intensities recorded for 15, 30 and 60 minutes were 4.40, 3.40, and 2.20 inches per hour, respectively. Those values correspond closely to the 50-year intensities estimated by Dorroh[1] for that locality. It should be pointed out, however, that these frequency estimates are for point rainfall and have an indefinite relationship to the probability of such intensities recurring at various points within the watershed to produce similar runoff.

Isoheyts for the total rainfall in the July 21-22 storm show a "slope" of up to 1.5 inches per mile from the storm center. This indicates that several storms of similar runoff-producing characteristics could occur within the watershed during their recurrence interval at a particular point. Therefore, it appears that on Southwestern watersheds of sufficient size to permit considerable variation in the location of rainfall centers, runoff associated with a 50-year rainfall, for example, must have a much shorter recurrence interval than once in 50 years. The runoff probability in relation to that of a point rainfall must be dependent to some degree on the size of the watershed and a characteristic areal distribution of the high runoff-producing rains.

Data on rainfall time-depth-area patterns such as were measured for the July 19 and July 21-22 storms should permit a mathematical approach to the determination, for watersheds that vary in size and are subject to similar intense storms, of the relationship between (a) probability of recurrence of a storm of given runoff-producing potential and (b) a particular point rainfall expectancy.

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[1] Dorroh, John H., Jr., Soil Conservation Service, unpublished maps, Rainfall Intensity Characteristics, for Arizona, Colorado, New Mexico and Utah, 1950.

FREQUENCY OF RUNOFF VOLUMES FROM 1-5-DAY STORMS STUDIED

R. W. Baird and Monroe A. Hartman, Waco.--The frequency of one-to-five-day storm runoff volume was computed for watershed W-1, a 176-acre area with no special conservation practices. Only annual storms were used with duration of storm assumed to be one day, two days, three days, four days and five days. The Potter method of computing frequency was used as it is discussed in SCS-TP-78, May 1949. The frequency for one- and five-day storms was also computed by using the Hazen method.

The 1944 one-day storm, more than twice the size of the next largest, seems to be out of line in the 17-year record. The frequency for a one-day storm was, therefore, calculated by the Potter method for a 16-year record omitting the 1944 storm.

The results of these calculations are shown in the following table. It must be recognized that this is only an exploratory analysis, and conclusions should not be based on this brief study. However, the comparisons are interesting and suggest that further studies along this line might be worthwhile.

Frequencies of inches of runoff from a 176-acre watershed (W-1) at the Blacklands Experimental Watersheds, for the period 1938-54, computed by two methods

	Runoff as large or larger expected once in:				
	2 yrs.	5 yrs.	10 yrs.	25 yrs.	50 yrs.
1-Day storm:	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Gumbel-Potter.....	1.35	2.90	3.50	5.30	6.30
Hazen computed.....	1.23	2.45	3.60	5.40	6.90
Gumbel-Potter..... (1944 omitted from 16-yr. record)	1.30	2.00	2.50	3.50	3.60
2-Day storm:					
Gumbel-Potter.....	1.80	3.50	4.70	6.15	7.25
3-Day storm:					
Gumbel-Potter.....	2.00	4.10	5.50	7.35	8.75
4-Day storm:					
Gumbel-Potter.....	2.20	4.45	6.00	7.90	9.35
5-Day storm:					
Gumbel-Potter.....	2.25	4.55	6.10	8.05	9.55
Hazen Computed.....	1.58	3.80	5.05	8.00	10.50

Considerable work has been done on preparation of records for water yield studies. All records for stations now in operation are current and, unless extremely wet weather occurs next quarter, should be completed soon after January 1, 1956. Records from other stations at Riesel are mostly computed, but no work has been done on records from outlying stations (Tyler, Spur, Garland, Texas; Bentonville, Arkansas; and Muskogee, Cherokee, Guthrie, Oklahoma).

Ohio

MANURE-MULCH INCREASES ECONOMY OF WATER USE UNDER CORN

F. R. Driebelbis and L. L. Harrold, Coshocton.--On irrigated plots with manure-mulch, 938 pounds of ear corn per acre were produced by each inch of water. Comparable yields for unmulched irrigated plots were 535 pounds and for unirrigated check plots 321 pounds. The plots were on Muskingum silt loam. Data on yields, height of plants, and consumptive-use are tabulated in Table 1.

Table 1.--Corn yield, plant height, and consumptive use of water as affected by mulch and irrigation

Plot	Yield per acre		Average height of plants**	Consumptive use*		Corn produced per acre inch of water used in top 24 inches of soil
	Number of ears	Weight		Total 0-14"	Total 0-24"	
		Pounds	*Inches*	*Inches*	*Inches*	*Pounds*
J. Irrigated.....	12,200	6,730	63.3	11.64	12.59	535
K. Irrigated-mulch.	14,200	9,270	68.2	9.51	9.88	938
L. Check.....	6,670	3,600	56.2	9.43	11.23	321

*For period June 17 to August 17, 1955.
**August 4, 1955

Data on water use from the various soil layers for the period June 17 to August 17 are summarized in Table 2. Soil moisture content was raised to field capacity on all but the check plots each time one-half the available soil moisture in the 0-14-inch layer was exhausted. Soil moisture status was determined in the 0-24-inch soil layer throughout the growing season by means of fiberglass-gypsum blocks replicated nine times.

Table 2.--Consumptive use of water by sweet corn from various soil layers, June 17 to August 17, 1955

Soil layer	Water used in irrigated plot (J)		Water used in irrigated-manure mulched plot (K)		Water used in check plot (L)	
	Total	Per inch of soil	Total	Per inch of soil	Total	Per inch of soil
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
0-7	10.89	1.56	9.07	1.30	7.92	1.13
7-10	.27	.09	.13	.04	.37	.12
10-12	.24	.12	.15	.08	.56	.28
12-14	.24	.12	.16	.08	.58	.29
14-18	.38	.10	.15	.04	.72	.18
18-24	.57	.10	.22	.04	1.08	.18
0-24	12.59	.52	9.88	.41	11.23	.47

Ohio

SUBSOIL TILLAGE AND MULCH AFFECT CORN YIELD AND WATER USE

L. L. Harrold and F. R. Driebelbis, Coshocton.--Corn yield and water use varied widely between four tillage and mulch treatments on Keene silt loam in 1955. One area was subtilled in the fall of 1954, another in the spring of 1955, and another was not subtilled. These were all under mulch obtained by tilling alfalfa-timothy sod with a Graham-Hoeme plow. A fourth area was plowed in the conventional manner without the mulch treatment. Subtilling was accomplished by a heavy chisel operating to a depth of about 16 inches and in rows four feet apart. Fertilizer was applied behind the chisel. Soil moisture records were taken during the growing season by fiberglass-gypsum blocks that were placed in the 0-1, 1-4, 4-7, 7-10, 10-14, 14-24-inch soil layers.

At the end of the growing season, the soil moisture was lower in all depths than it was at the beginning of the season on all four areas. The extent of this decline in terms of inches water is given in the table below. For the 0-24-inch depth, the decline ranged from 2.57 inches on the fall subtilled area to 3.26 on the spring subtilled area. Rainfall for the season was 9.05 inches. This amount plus the decline in soil moisture gave a value of the total consumptive-use. Corn yields on the four areas are also given below. They were highest on the spring subtilled and lowest on the fall subtilled area. The yield on the latter area was somewhat depressed by a heavy stand of foxtail grass.

Decrease of soil moisture in various soil layers, rainfall, and total consumptive-use of water by corn under various tillage practices, June 2 to September 6, 1955

Soil depth	Fall subtilled plus mulch	Spring subtilled plus mulch	Mulch without subtillage	Plowed-no mulch, no subtillage
Inches	*Inches*	*Inches*	*Inches*	*Inches*
0-1	0.08	0.12	0.06	0.06
1-4	.17	.31	.28	.25
4-7	.31	.46	.49	.35
7-10	.28	.47	.33	.40
10-14	.41	.54	.38	.40
14-24	1.32	1.36	1.68	1.30
Total 0-24	2.57	3.26	3.22	2.76
Rainfall	9.05	9.05	9.05	9.05
Total consumptive use	11.62	12.31	12.27	11.81

Corn yield under various tillage practices

	Fall subtilled plus mulch	Spring subtilled plus mulch	Mulch without subtillage	Plowed-no mulch, no subtillage
	Bushels	*Bushels*	*Bushels*	*Bushels*
Yield per acre	65.8	94.8	86.7	85.5
Corn produced per inch of water used	5.66	7.70	7.07	7.24

Michigan

CULTURAL PRACTICES REVISED ON CULTIVATED WATERSHEDS

G. A. Crabb, Jr., East Lansing.--The Michigan Agricultural Experiment Station's Advisory Committee on Hydrologic Research has approved a revision of cultural practices on the cultivated watersheds to begin at the end of this crop year. The new practices will see watershed A in a continuous corn rotation, and watershed B in a minimum tillage rotation. Watershed A will be farmed to continuous corn, using a minimum tillage practice beginning next spring, followed by a winter cover crop to be plowed under. Fertilizer will be used as indicated by soil and plant tests. Corn will be planted in the plow-plant manner of minimum tillage, using a 14-inch moldboard plow followed by a 28-inch plow-packer. Seeding will follow tillage immediately. The minimum tillage rotation on watershed B will consist of a rotation of corn-oats-alfalfa brome (2), using the plow and plow-packer tillage implements as described above. In the case of oats, a seeding unit will be attached behind the plow-packer, and seeding and tillage will be accomplished simultaneously.

Plaster-of-Paris soil moisture units have been ordered for installation upon the cultivated watersheds. Their use will amount to a reinstallation of a simplified version of the soil moisture studies discontinued in 1953.

Arizona

TRIALS INDICATE NITROGEN MAY AID IN RANGE IMPROVEMENT

Joel E. Fletcher, Tombstone.--A preliminary test was conducted on one soil type to ascertain whether nitrogen fertilizer applications in connection with watershed management practices might influence water yields and sediment production.

Past range fertilizer studies have been termed inconclusive because rainfall was not considered and the resulting interaction on occasion gave decreases in yield from fertilizer.

In the present test, 135 pounds per acre of nitrogen were applied to the treated plots after 4 inches of summer rain had fallen. The plots consisted of a control with no treatment, a fertilized plot of mixed grama grass and three awn grass, and a fertilized plot of Rothrock's grama grass. The results were as follows:

Treatment	Yield per acre	Protein content	Yield of protein per acre
	Pounds	*Percent*	*Pounds*
Control.....	508	7.2	36.8
Rothrock's grama...	2,780	11.9	331.9
Grama, three awn...	3,777	11.8	446.8

It is indicated that the treatments gave 9-fold and 12-fold increases in protein yield for Rothrocks's grama and mixed grama-three awn grass plots. It would appear, therefore, that a study of the fertility factors involved in our range management and revegetation influence studies would be interesting and productive.

SEDIMENTATION

Mississippi

EFFECT OF SANDBED MOVEMENT ON SAND TRANSPORT TO BE STUDIED

Russel Woodburn, State College. --Preliminary evidence indicates that rather extensive disturbance, or temporary scour, takes place during flood flow on sandbed streams. The amount and nature of this sandbed movement is probably significant in the over-all sand transport of the channel. The geometry-hydraulics relationship of the channel may be considerably altered during flood flow if extensive sand movement takes place.

Two rather extensive installations have recently been made in Big Sand Creek, in Carroll County, to attempt to get at some aspects of this phenomenon. Brass sash chain, steel sash chain and ropes were installed vertically, downward to a depth of 5 feet, at a number of points in the sandbed. A surface installation of log chain was made with lengths 25 feet to 45 feet for plotting bed configuration. The positions of these chains will be investigated after flood flows in an attempt to learn the depths of disturbance.

Typical "standing waves" which apparently are associated with bed disturbance, are often observed, even with moderate to small increases in stage. In late September, following a local high intensity rain, standing wave flow to an exaggerated extent was observed in the channel of the "arroyo" in Lafayette County. With only 0.5 foot average flow depth and mean velocities of 4 to 5 feet per second, waves reached a height of 15 inches, trough to crest, and were 5 feet apart, crest to crest. The sandbed was noted to have a wave configuration in phase with the surface but of much less amplitude. The entire standing wave train in a reach collapsed after two or three minutes, leaving the sandbed smooth, and the cycle began again.

Gully Sediment Production Study Also Started

Plans were made for setting up a comprehensive evaluation study of gully treatment as affecting sediment production rate. After extensive search, sites were located in Lafayette County, Tallahatchie County and Carroll County.

At the end of the quarter, detailed plans had been completed and field surveys of the gully study sites had been completed.

HYDRAULICS

Minnesota

TESTS SHOW HOOD INLET LETS PIPE SPILLWAY FLOW FULL UNDER LOW HEAD

F. W. Blaisdell, St. Anthony Falls, Minneapolis. --The hood entrance to a closed conduit spillway culvert is formed by cutting a pipe on an angle and placing the pipe so the crown projects beyond the invert, forming a hood over the entrance to the pipe. Tests at Oregon State College have shown that such an inlet will cause the closed conduit spillway to flow full, even though the spillway barrel may be on a steep slope.

The attractiveness of this type of inlet is at once apparent. It will eliminate the need for many drop inlets, to which strong objections have been voiced through the years because of cost and very high minimum height requirements for proper operation; it will provide a very economical spillway for the thousands of farm and ranch ponds constructed annually, and will make the job of providing proper spillways for these ponds much easier, both from the standpoint of "selling" and installation; and it will be very useful and economical for many of the detention reservoir spillways used in the watershed protection program.

Tests to determine the minimum angle of the hood to insure full flow were conducted with a thin-edged entrance (thickness = 0.015 of a pipe diameter). This entrance projected into the head pool to form a re-entrant entrance, since this was believed to be the worst condition that would be encountered in practice. The slope of the spillway barrel was 20 per cent.

These tests showed that the hood should be 3/4 of a pipe diameter long. In other words, the top of the pipe should project over the bottom of the pipe by 3/4 of a pipe diameter to insure that the spillway would flow full at a minimum head. It was noted that the spillway actually tried to flow full before the tip of the hood was submerged, but there was insufficient seal (depth of water) at the entrance to prevent air from being sucked in. When the hood length was 1/2 of a pipe diameter, similar to that recommended in the Oregon bulletin, the spillway would flow full but at a somewhat higher head pool level than for the 3/4 of a pipe diameter hood. Air flow stopped and full pipe flow was continuous for the 3/4 of a pipe diameter hood when the head pool level was 1.4 pipe diameters above the inlet invert elevation.

Orifice-type flow was observed for all hoods less than 3/4 of a pipe diameter long. This is further evidence that the hood length should be at least 3/4 of a pipe diameter.

Pipe wall thicknesses in excess of 0.015 of a pipe diameter did not affect detrimentally the filling of the pipe. Wall thicknesses as great as 0.22 of a pipe diameter were tested. The tests also showed a lesser entrance loss coefficient for the thicker-walled pipes.

Tests to determine the effect of shape of the inlet lip on the performance were considered but have been abandoned, at least temporarily, because of the difficulty of forming special shapes and the desire to hold to a rapid test schedule. Tests on rounded entrances and corrugated pipe entrances are among those deferred. It may be desirable to test corrugated pipes full-size rather than resort to models.

Anti-vortex devices. --Development of an anti-vortex device was confined to observational tests only. These observations were made on an entrance with a 3/4 of pipe diameter hood. The work was carried out on the assumption that vortices were undesirable and the anti-vortex device should eliminate the vortex or reduce its strength so it would have a negligible effect on the spillway performance.

That vortices would greatly reduce the spillway capacities was confirmed by one series of tests in which no anti-vortex device was used. Strong vortices developed at low submergences of the inlet which reduced the capacity of the spillway to one-third of its capacity when the vortices were absent. The reduction in capacity and the vortex intensity decreased as the head pool level was raised. Although vortices still existed, their effect on the spillway capacity was insignificant, for this particular test, when the head pool level was 6 pipe diameters above the inlet invert. No vortices were observed and an anti-vortex device is not needed for weir flow which is present until the head pool level exceeds the inlet crown. However, the tests vividly show the necessity of an anti-vortex device when the inlet is submerged and the pipe is full.

An anti-vortex wall 3 pipe diameters long and 2 pipe diameters high was welded to the top of the inlet on the pipe centerline. This wall projected 2 pipe diameters upstream of the hood with 1 diameter welded to the top of the pipe. None of the wall projected below the crown of the pipe, so the wall had no effect on the flow until the inlet crown was submerged by the rising head pool. This anti-vortex wall worked quite well, and was used as a starting point to determine the effect of the wall on vortex control. However, it was noticed that vortices had a tendency to form at the downstream end of this wall, so the wall was moved downstream until only 1.5 pipe diameters of the wall length projected upstream of the hood tip. The 1.5 diameters length welded to top of the pipe prevented vortex formation at the downstream end of the wall, but tendency for vortices to form at the upstream end of the wall was increased. When the anti-vortex wall was made 3.5 pipe diameters long so that 2 pipe diameters projected upstream of the hood tip and 1.5 pipe diam-

eters were welded to the top of the pipe, the vortex control was good. This is apparently the minimum wall length that should be used.

With this length of anti-vortex wall, the wall height was reduced to 1.5, 1.0, and 0.5 pipe diameters, successively. The wall 0.5 of a diameter high seemed to let in considerable air at frequent intervals, whereas the wall 1 pipe diameter high seemed as satisfactory as the higher walls.

These observational tests indicate that an anti-vortex wall located on the pipe centerline should be 3.5 pipe diameters long, with 1.5 pipe diameters attached to the outside crown of the pipe and with 2 pipe diameters extending upstream of the hood tip. The wall should be 1 pipe diameter high. Even with this anti-vortex wall, intermittent or transient vortices were observed when the wall was submerged. However, these vortices were not continuous, they seemed to have little strength, and they admitted only small amounts of air to the pipe at irregular and infrequent intervals.

After the minimum dimensions of the anti-vortex wall located on the pipe centerline had been determined, tests were made to quantitatively evaluate it as well as to evaluate two modifications of this wall. A fourth test series was run on an anti-vortex wall 3 pipe diameters long by 2.5 pipe diameters high located perpendicular to the pipe centerline. These quantitative data on the anti-vortex wall performance have not yet been analyzed, but indications are that the perpendicular anti-vortex wall, although far superior in its action to no wall, is not as effective as the longitudinal wall located on the pipe centerline.

Tests on the scour of the dam face in the vicinity of the inlet and the area of the dam requiring protection from scour are just beginning.

Oklahoma - New Mexico

HYDRAULIC MODEL TESTS VERIFIED BY FLOOD

W. O. Ree, Stillwater, Okla., and R. B. Hickok, Albuquerque, New Mex. --Model studies of a flume constructed by the Southwest Hydrologic Project were under way when a flood experienced by the prototype provided a verification of the laboratory tests.

The flume was installed at the outlet of the Alamogordo creek experimental watershed in New Mexico in 1954. It was designed as a critical flow meter with a trapezoidal throat section and parabolically curving sidewalls in the approach and outflow sections. It was constructed with thin shell concrete facings on earthfill forming the flume walls. The trapezoidal throat section had a 20-foot bottom width, 2:1 side slopes, and a depth of 13 feet. The design capacity was approximately 9,000 cfs. Completion of bank and bed scour protection works anticipated as being necessary both above and downstream from the measuring flume was awaiting laboratory test results to determine the design when a flood occurred on July 22 for which the peak exceeded the capacity of the flume and has been estimated to have been about 10,000 cfs. As a result of overtopping and bypassing around one end of the concreted structure, and lack of the needed scour protection both above and downstream, severe damage occurred to the measuring flume as shown in the accompanying pictures. (Details regarding the flood and the storm which produced it are included elsewhere in this report, under New Mexico.)

A one-fortieth size model of the field structure had been constructed. Experiments were being made to calibrate the structure and to determine measures necessary for its protection against flood damage. Preliminary tests had indicated the probable hydraulic behavior of the flume, and tests of various protective works were underway when the flood occurred. Field inspection after the flood showed close correspondence between damage to the model and to the prototype. The model was tested again using the flood discharge rate in order to provide a still better comparison.

PROTOTYPE

MODEL

Before

After

After

The results are shown in the accompanying photographs. Before and after views are given of both the prototype and the model. The view is looking downstream toward the structure.

Both model and prototype show that nearly all damage occurred on the right side. The position and alignment of the structure with respect to the approach channel caused the stream to attack the right bank just at the flume. Scour resulted at the flume and a back eddy deposited material upstream on the right bank. This behavior is evident in both sets of photographs.

Protection against the upstream damage can be obtained by use of riprap. However, size and location of the stone must be properly selected. The downstream protective works have not been decided.

SCS AND SWCRB HOLD JOINT MEETING ON DRAINAGE, IRRIGATION

Research and operations personnel working in drainage and irrigation in the Eastern States have scheduled a meeting in Chicago December 8 - 10. The conference was planned jointly by the Soil and Water Conservation Research Branch, Agricultural Research Service, and the Soil Conservation Service. The Chicago meeting is similar to a Western conference of irrigation and drainage engineers in Denver last winter.

Topics for discussion include soil moisture-plant relations, evaporation and infiltration, application of weather data to drainage and irrigation work, basic hydraulic studies of tile junctions, compilation of watershed data for use in drainage and irrigation work, status of SCS national engineering handbook, irrigation equipment and water resources, water quality and soil salinity, irrigation of specific crops in particular areas, drainage in specific problem areas.

SOUTHEASTERN TIDEWATER STATION GETS OFFICE-LAB BUILDING

Long-awaited office-laboratory building, left, at the Fleming, Ga., location was dedicated Oct. 11 in cermonies sponsored by Board of Supervisors, Coastal Soil Conservation District. At right is staff of station; Left to right, A. E. Royer, soils; H. G. Ukkelberg, crops; R. L. Green, agricultural engineering, superintendent of station; Mrs. Mildred Futch, clerk; and J. M. Daniels, agricultural engineering.

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OUR SOIL ★ OUR STRENGTH